Mobile Radio Technology

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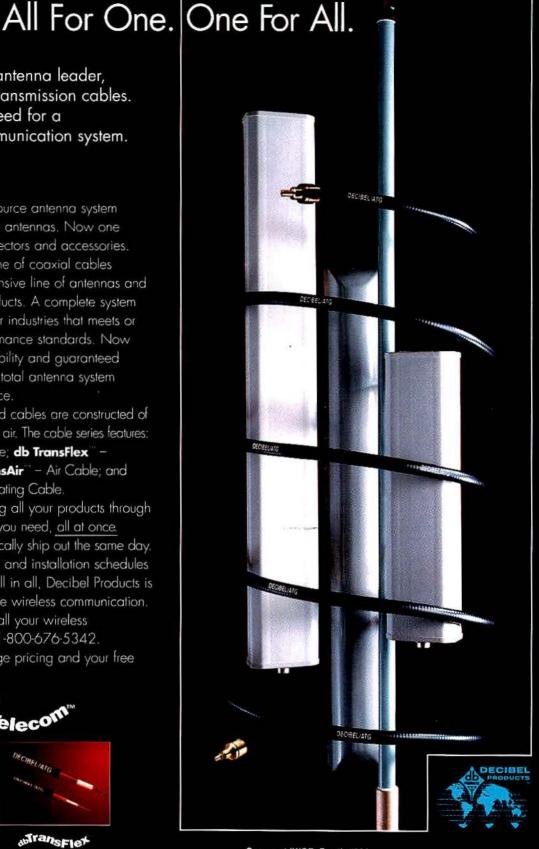
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On the cover: Cellular digital packet data systems require testing independent of AMPS functions. Photo courtesy of Hewlett-Packard, Spokane, WA.

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Ugly spectrum: A beautiful perspective



Once upon a time, radio communications equipment dealers were in the business of helping other business owners to buy, install and use mobile and portable radios to communicate with their employees. Radio communications among employees and supervisors facilitates safety and more efficient ways to transact business. Sometimes equipment manufacturers themselves would provide communications systems directly to customers, especially to large businesses. Frequencies at VHF lowband, VHF highband and UHF sometimes were crowded, and sometimes were overcrowded, especially in urban areas. The frequencies were shared among many users, and interference among them varied from causing little problems to enormous problems, depending on location and the nature of the businesses sharing the frequencies.

The federal government provided some relief to overcrowded frequencies when it reallocated from TV broadcasting some spectrum at 800MHz and 900MHz and assigned some of it to business and industrial private radio use. Exclusive frequency assignments were made available to licensees with a sufficient number of radio units in operation on their channels. The future looked bright.

Then the federal government decided to raise money by auctioning spectrum. The very spectrum that held promise for private radio, in part because of its exclusive assignment to individual licensees, is the easiest to auction.

There's also the notion of "frequency practicality." These 800MHz and 900MHz frequencies use relatively small base station antennas. In an era of public sensitivity to towers, smaller is better. The range

covered by these frequencies tends to be less than the range at lower frequencies, making them a little more appealing for use by cellular systems the reuse the same frequencies at various towers within a given area. Many business and industrial private radio systems are designed with tall towers that cover a large area without reusing frequencies, a method that works well for communicating within a given organization.

Enter the LEOs.

LEOs are low earth-orbiting satellites that are used to provide radio communications that carry telephone calls; computer messages including text files, graphics, video and email; location information and plenty of other communications known as "wireless." LEO carriers are seeking spectrum. VHF and UHF spectrum appeals to LEO carriers for several practical reasons having to do with exchanging radio signals between satellites and wireless phones, pagers, computers and other devices on the ground.

Interference from VHF and UHF business and industrial private radio systems would make it difficult for LEOs to share the same frequencies. The fact that most of these VHF and UHF private radio systems do not have exclusive frequency assignments makes it difficult to auction them for land-based public wireless systems, too. In short, these VHF and UHF business and industrial private radio frequencies are so damn ugly that they repel wireless and LEO carriers.

In the 1970s, when the 800MHz and 900MHz spectrum reallocations took place (and before LEOs), who would have thought that the same problems that led business and industrial private radio interests to seek more frequencies would become a passive, yet strong, defense against the destruction of private radio?

And then there's spectrum refarming. Spectrum refarming is supposed to relieve some of the overcrowding on business and industrial private radio frequencies by changing some of the technical and operating regulations that will allow more radios to be used in the VHF and UHF bands without causing more interference. It will be one more cruel twist if the effect of refarming is to make these frequencies more suitable for wireless or LEO carriers, and then they persuade the federal government to take them away. Face it, the feds need little encouragement to take frequencies away if there is a way to auction them.

The notion of spectrum lease fees continues to pop up in published reports of spectrum matters being considered by the federal government. These fees would be paid by business and industrial private radio users for the privilege of continuing to use present frequencies and perhaps, just perhaps, the privilege of using some new ones. It's sad to think that maybe the best way to keep these frequencies is to keep 'em ugly, and it's reasonable to think that some lease payments may be involved.

Towers? Get lost, already

Municipal governments continue to frustrate efforts by wireless telecommunications carriers to construct towers where the carriers say they need them and where the governments don't seem to want them.

The FCC preempted local and state government jurisdiction over tower placement, but cities are finding ways to circumvent the feds with the aid of sympathetic judges. Scenario: the FCC preempts; the city goes to court; a judge decides in favor of the city, overruling the FCC.

Another method is being tried in Vermont. The state's Department of Public Service wants the legislature to consider whether state and local agencies could impose RF radiation safety guidelines through private contracts that are more restrictive than the FCC's. Contractors who build antennas on state property could be regulated through contract authority.

The Personal Communications Industry Association has issued a list of criteria that represent a barrier to entry for carriers and has asked the FCC to declare that actions by cities to the contrary are preempted:

any moratoria (including extensions) exceeding three months in duration.

☐ any failure to issue a written opinion on a zoning decision within a three-month period.

☐ any action to deny permitting or access on the basis of licensee characteristics (such as financial, legal or ownership qualifications).

any action that prohibits or unduly restricts the installation of antennas on existing structures.

any action that directly or indirectly discriminates against new providers of wireless services.

Just let cities try to find their way around that! (Somehow, they will, won't they?)

Sometimes, it would help if the FCC itself were to adhere to such carefully crafted requirements when it comes to processing petitions and other requests for relief.

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- O The R-2660 with 3:1/6:1 iDEN™ test capability (AD)
- O The R-2670 with ASTRO®, SmartZone™, SMARTNET™ and SECURENET™ capabilities (AE)
- O The R-2680 with optional MPT 1327 (AH)
- O The Micro RF Isolator (AF)
- O All of the above (AZ)

- 2. What do you usually test?
 - O Two-way radios ([A) O Pagers ([E)
 - O Trunked radios (JF) O Cell sites (JT)
- O Encrypted systems (JG) O Cell phones (JU)
- 3. When do you plan to buy test equipment?
- O In 1 month (HA) O 7-12 months (HC)
- 2-6 months (HB) O More than a year (HD)
- 4. Do you buy test equipment in your company or does someone else? O I do (EA)
- O Someone else ______(EB

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Calendar

April

- 21-24—Telecommunications Resellers Association's 1997 Spring Conference and Exhibition, sponsored by TRA, Marriott Riverwalk, San Antonio. Contact: 202-835-9898.
- 22-24—International Wireless Communications Expo, co-sponsored by Mobile Radio Technology, Las Vegas Sands Convention Center, Las Vegas, Contact; 800-288-8606.
- 23—Radio Club of America breakfast meeting, Mirage, Las Vegas. Speaker: David Weisman, attorney; Meyer, Faller, Weisman & Rosenberg, \$10, Contact: 214-580-1911.

May

5-7—Vehicular Technology Conference, sponsored by IEEE Vehicular Technology Society, Hyatt Regency at Civic Plaza, Phoenix. Contact: Wendy Rochelle, 908-562-3870; Fax: 908-981-1769.

Inne

- 2–5—Expo Comm USA/Comdex/Spring '97, sponsored by E.J. Krause & Associates, Georgia World Congress Center, Atlanta, 301-986-7800.
- 2–5—Supercomm, sponsored by USTA and TIA, New Orleans Convention Center, New Orleans, Contact: 202-326-7300.
- 3–5—Canadian Wireless, sponsored by the Canadian Wireless Telecommunications Association, Montreal. Contact: 613-233-4888.
- 8–12—IEEE International Conference on Communications, sponsored by Bell Canada, Nortel Technology, Stentor, Motorola, Alcatel, Lucent Technologies, Teleglobe Canada, BellCore, Harris Farinon Canada, Bell Canada International, BCE Mobile Rogers Cantel and VISTAR; Palais des Congrés, Montreal. Contact: 905-615-6507.
- 9–11—Communications Expo/Show of the Americas, Miami Convention Center, Miami. Contact: Jackie Gonzales, 305-412-9000.
- 22–26—UTC National Conference & Exhibition, sponsored by UTC, The Telecommunications Association, Oregon Convention Center, Portland, OR. Contact: 202-872-0030.

August

10–14—International Association of Public-Safety Communications Officials (APCO) National Conference, Charlotte, NC. Contact: 904-322-2500.

September

10–12—Personal Communications Showcase, sponsored by the Personal Communications Industry Association, Dallas Convention Center, Dallas. Contact 800-326-8638.

October

27–29—Wireless Apps, sponsored by the Cellular Telecommunications Industry Association, Seattle Convention Center, Seattle. Contact: Francesca Dea, 702-739-4025, or Tim Avers, 202-736-3203.

November

- 6-7—AMTEX, sponsored by the American Mobile Telecommunications Association. Hilton at Walt Disney World Village, Orlando, FL, 202-331-7773.
- 6-8—Second International Congress on Commercial Trunked Radio, sponsored by the International Mobile Telecommunications Association, Hilton at Walt Disney World Village, Orlando, FL, 202-331-7773
- 12–16—Communications Marketing Conference, sponsored by the Communications Marketing Association, Holiday Inn International Drive Resort, Orlando, FL. Contact: Bernie Brownson, 303-371-8182.
- 21—Radio Club of America, Communications Symposium, 88th Anniversary Dinner and Awards Presentation, New York Athletic Club, New York, Contact: Gerri Hopkins, 908-842-5070.



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echnically speaking

Using attenuators to determine fade margin

By Harold Kinley, C.E.T.

It is always useful to know just how much fade margin, or "head room," we have to spare in our communication system. The procedure for determining the head room can be applied to radio-receiving, as well as to remote-control lines. This involves the use of RF attenuators and audio attenuators. High-quality RF attenuators for use at VHF and higher frequencies are difficult to build. Commercially built attenuators that will operate well into the gigahertz range are available at reasonable cost.

On the other hand, attenuators for audio frequency work (pads) are not so critical, and thus they are easily built from ordinary resistors. Precision resistors are recommended because an accumulation of tolerances can reduce the accuracy of the attenuation of the pad. For the type of use described in this column, a resistor tolerance of 1% or 2% should do well.

Radio reception

Radio systems are usually designed to provide a signal level well above the 12dB SINAD sensitivity level of the receiver. Otherwise, the background noise would be annoying, and there would be no built-in fade margin or head room. In spite of some claims to the contrary, atmospheric

Kinley, a certified electronics technician, is regional communications manager, South Carolina Forestry Commission, Spartanburg, SC. He is a member of the Radio Club of America. He is the author of Standard Radio Communications Manual: With Instrumentation and Testing Techniques, which is available for direct purchase. Write to 204 Tanglewylde Drive, Spartanburg, SC 29301. Kinley's email address is hkinley@aol.com.

ATTENUATOR RECEIVER SINAD METER

Figure 1. This setup can be used to determine how much "head" room or fade margin is built into the radio system.

weather conditions and other environmental conditions can and do affect signal propagation, even at VHF highband frequencies. Signals at specific locations do not remain at a constant, unwavering level. The level varies under various conditions and at various times of day.

Just how much fade margin does your system have at a particular location? You don't have to guess. The following test procedure can tell you exactly how much fade margin you have. Of course, the measurement is only valid for the particular time and place of the measurement. Obviously, the greater the fade margin, the more reliable the system will be under adverse propagation conditions. If you make a measurement when the propagation conditions are excellent and find that your fade margin is only a few decibels, then you may have a complete loss of signal under poor conditions.

If you make such a measurement when the propagation conditions are at the lower extreme, and you still have a fade margin of several decibels, then your communications system is apparently up to the task. It is difficult (if not impossible) to design a communications system that produces a strong signal in all parts of the desired coverage area at all times. A communications system designed to achieve this goal (or as near as possible) would probably be cost-prohibitive for most of our customers. A more reasonable and pragmatic approach is usually taken, and systems are designed for a lower percentage of reliability.

Critical communications systems are often designed for 99% reliability or better. This just means that the built-in fade margin is greater than for a system designed for 90% to 95% reliability. Changing a communications system design from 90% to 95% reliability requires consider-



Photo 1: Kay Elemetrics' model 4460 programmable attenuator. Photo courtesy of Kay Elemetrics, Lincoln Park, NJ.

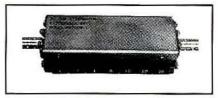


Photo 2: Pasterneck Enterprises' model PE7008-1 pushbutton attenuator. Photo courtesy of Pasterneck Enterprises, Irvine, CA.

ably more expense, and moving from 95% to 99% drastically increases the expense. Critical links are designed for line-of-sight communications with a fairly high built-in fade margin.

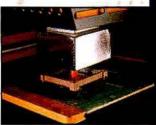
The setup shown in Figure 1, below left, is used to measure fade margin. The attenuator can be the pushbutton or switch type, or it can be a programmable type. (See Photos 1 and 2 above, and Figures 2, 3 and 4 on page 97.) Before running the test, make sure that you are using a mobile radio of the type generally used in the communication system and that the receiver meets the sensitivity specification of the manufacturer. Also, make sure that the tone (1kHz) used to modulate the base station transmitter matches the notch of the SINAD meter. Otherwise, the measurement will not be valid.

Go to the location to be checked, and with the base station transmitting a constant 1kHz tone at about 90% system deviation, start with no attenuation switched in. (Disable the tone, or digital squelch code, on the transmitter first to prevent irritating other users of the system). The SINAD meter should indicate a good SINAD reading (better than the minimum you require). Increase the attenuation until the SINAD meter indicates the desired minimum SINAD reading. The amount of attenuation switched in is equal to the fade margin of the system at that particular location. You may want to make several measurements within that particular area and average the results. This may provide a more realistic picture than a single

(continued on page 97)

CHIPMASTER

Patent Pending



Plastic Socket



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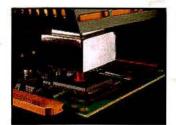
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CDPD presents new challenges for RF testing

Even when cellular channels are dedicated exclusively to use for cellular digital packet data (CDPD), RF performance tests should be conducted on the CDPD systems to assure that it is not degrading the AMPS system.

By Tom Shannon and Jeff Owen

Even though cellular digital packet data (CDPD) service is generally overlaid on an existing advanced mobile phone service (AMPS) system, it still requires a battery of RF performance tests independent of those conducted to evaluate its AMPS counterpart. It is the complementary nature of CDPD that necessitates effective RF measurements, because the CDPD system has the potential to degrade AMPS system performance. Although these tests are not complex, they vary somewhat from those required to evaluate an AMPS system.

Considerable attention has been paid to these RF measurements as more CDPD systems have been deployed, because CDPD performance has often been less than optimum. Some of the most important deficiencies are related to the performance of the CDPD transmitter and receiver. A brief description of how CDPD

Shannon is applications engineer, and Owen is product manager, for Hewlett-Packard, Spokane division, Spokane, WA. works will demonstrate the importance of RF testing.

CDPD is a scheme in which a packet data service can be added to an existing AMPS voice cellular system for an incremental increase in base station cost. CDPD was originally conceived to transparently complement an AMPS system, making use of AMPS channels that are not being used by voice traffic as shown in Figure 1 below. This concept allows many users to occupy a single channel and has the potential to supplement the income from the AMPS system, at little additional cost to the service provider.

CDPD does not require much additional hardware. It essentially "bolts onto" the existing AMPS base station equipment. Both the AMPS and CDPD systems have full-duplex capability and 30kHz channels, and they generally share frequency reuse, coverage and power levels.

The Search for Acceptance

CDPD has always been touted as a simple, inexpensive, rapidly deployable way to provide mobile data service. Its appeal has been for applications such as order entry,

inventory control, remote utility reporting, package tracking, electronic trading and other applications that require transmission and reception of small amounts of data.

This simple scenario would lead to the assumption that CDPD would gain immediate acceptance. This has not been the case for several reasons. First, pricing structures have not been low enough to drive competitors with dedicated data services from the market. These competitors have developed nationwide networks that cover as much as 95% of the United States. CDPD is the lowest-cost service, but it is still not low enough.

Technical hurdles have made it difficult to develop this seemingly simple system into a commercially viable, reliable service. Some services providers have been successful in deploying CDPD systems through hard work and determination. Their efforts have been focused on a core set of end-user applications.

The development of end-user applications has not kept up with the deployment of CDPD, which is probably the most important reason why CDPD has not been more successful. Because few CDPD software applications have been written, customers must develop their own—a major hindrance to market acceptance.

Lack of an accepted standard has also hindered growth, although this will no longer be the case after adoption of System Specification 1.1 by the Telecommunications Industry Association (TIA) and the American National Standards Institute (ANSI). The CDPD Forum, a group sponsored by service providers that created the specification, has presented its completed work to the TIA and ANSI for consideration and ultimate adoption as a national standard.

Even with these shortcomings, the appeal of CDPD has lead to its implementation in many of the top U.S. markets, a testament to its inherent viability. Still, there are currently fewer than 10,000 CDPD users nationwide,

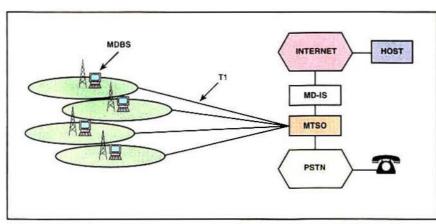
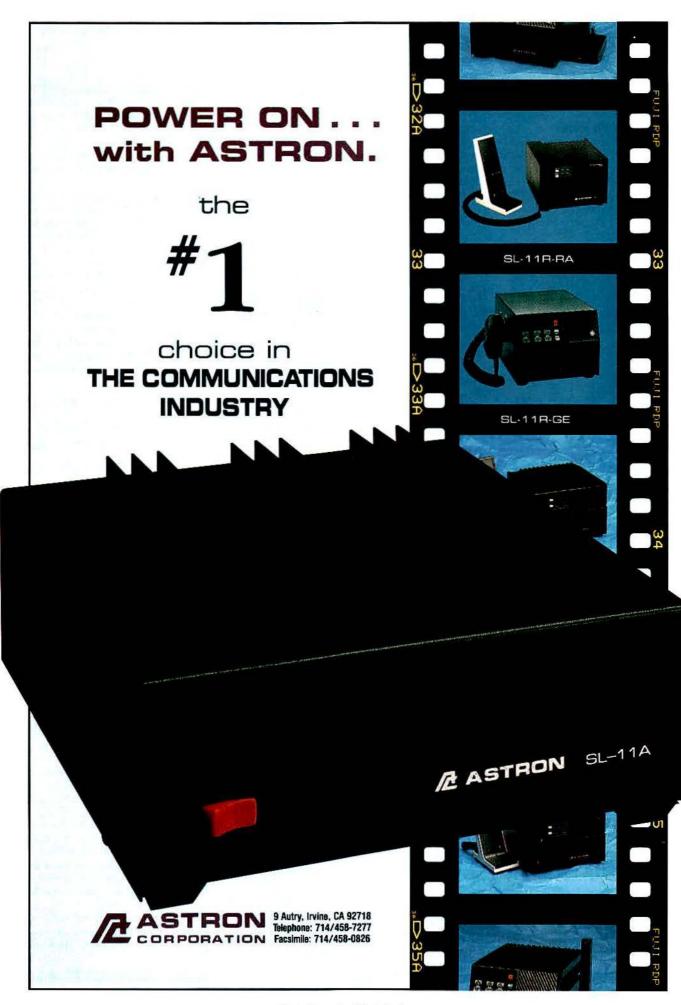


Figure 1. The CDPD hardware overlay on an AMPS system is complementary.



compared to more than 43 million cellular and PCS users for voice service.

How CDPD works

There are two methods of deploying CDPD. The first is through "sniffing and hopping." In this technique, a dedicated receiver in the CDPD system called a "sniffer" samples each 30kHz AMPS channel every few milliseconds and determines whether voice traffic is present.

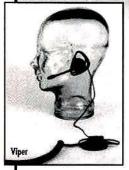
The most important role of the sniffer is to detect the AMPS system powering up as a call is assigned to the channel that CDPD is using. When a call is detected, the CDPD system looks for a CDPD-assigned channel that is not in use. (See Figure 2 on page 14.)

If voice traffic is detected on one channel, the system seeks out another CDPDassigned channel. When an unoccupied channel is located, the system hurries to transmit packets of data until AMPS traffic is detected. The CDPD system then immediately seeks out and switches to another unoccupied channel. CDPD was originally designed to work this way because it requires nothing from the AMPS system but an empty channel on which to transmit and receive.

It is important to note that proper operation of the sniffer receiver is essential if this method is to be successful because accurate detection of AMPS traffic is the most direct determinant of CDPD performance. For example, one of the problems that has occurred with CDPD systems is a phenomenon called "channel sealing," in which CDPD traffic impedes AMPS traffic on supposedly vacant channels. Channel sealing occurs when AMPS thinks a channel is too noisy to be used. (It does not differentiate CDPD traffic from interference and noise). As long as the CDPD channel

If the "noise" level is too high, the AMPS system will shut down the voice channel, making it unavailable for communication.





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dwell time is less than a certain period (the milliseconds required by the AMPS system to determine whether a channel is usable), AMPS will not seal the channel. (See Figure 3 on page 14.)

If the "noise" level is too high, the AMPS system will shut down the voice channel.

If the "noise" level is too high, the AMPS system will shut down the voice channel, making it unavailable for communication. It is possible that a malfunctioning CDPD system could shut down most or even all AMPS channels, with catastrophic results.

The other CDPD deployment technique is used when sniffing and hopping provides unacceptable results. This most often occurs in metropolitan areas where there is heavy AMPS traffic. In this situation, transmission latency occurs in CDPD service because AMPS traffic has priority. If the AMPS traffic is nearly continuous on every channel (an increasingly common occurrence in some areas), the CDPD system must wait for it to clear. This can take a long time at peak traffic periods. As a result, subscribers experience significant delays.

To combat this problem, some service providers have dedicated one or two AMPS channels to CDPD service. This eliminates

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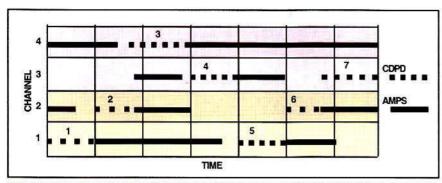


Figure 2. Forced hopping: The sniffer detects AMPS energy, causing the MDBS to shut down the forward channel and hop in concert with the MES to a new channel to resume data transmission.

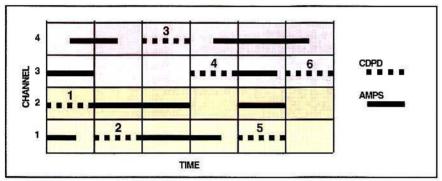


Figure 3. Planned hopping: A long CDPD data stream hops between channels for a specific defined period of time (equal channel dwell time).

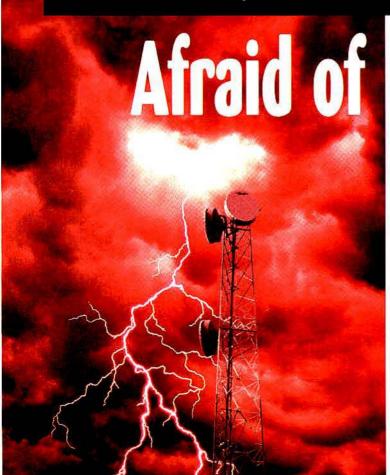
the need for sniffing and hopping because there is no need to search for vacant channels. On the other hand, it also negates the original appeal of CDPD, its ability to be overlaid on existing AMPS channels without requiring dedicated spectrum. However, because of the aforementioned problems, channel dedication is increasingly becoming the method of choice.

CDPD tests

Because the performance of both the CDPD system and the AMPS system that it complements depends in large measure on the proper operation of RF functions, comprehensive RF testing is essential. This applies not only to system commissioning, but to periodic maintenance as well. CDPD base station tests can be divided into four areas: transmitter tests, receiver tests, sniffer tests and system tests (which are reports of protocol data being exchanged by the mobile data base station (MDBS) and mobile end station (MES)). Each test is specified and defined in CDPD Systems Specification 1.1.

▶ Transmitter Tests — Six tests must be performed to verify proper transmitter operation. Transmit frequency-error tests are conducted to determine the difference

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between the measured center frequency of the CDPD modulated signal and the desired frequency. This measurement is required to ensure that the transmitted signal does not interfere with adjacent channels and to facilitate proper demodulation of the signal by the receiver.

Some instruments designed to make this measurement use digital signal processing to measure average peak positive and negative frequency deviation. This method has the advantage of being insensitive to the amount of time the signal spends at peak plus-or-minus frequencies.

Both total RF power and channel power must be measured to provide a complete picture of transmitter output. Total RF power is broadband output power and is measured with an RF power meter. Channel power is the power in a 30kHz bandwidth centered on the frequency specified for a given channel. It determines the area of

coverage for the individual radios of the base station and interference to distance cells.

Modulation accuracy, or the ability of the Gaussian minimum-shift keying (GMSK) modulator to maintain an accurate modulation index and peak deviation, is specified in System Specification 1.1 as a modulation index of 0.5 with $\pm 1\%$ accuracy. Measurement of adjacent and alternate channel power is required to ensure that power spread into these channels from the CDPD signal does not interfere with accurate voice or data communications.

Adjacent and alternate channel power is defined as the amount of transmitted power that falls into the adjacent, first alternate and second alternate channels. An adjacent channel is specified as a 30kHz bandwidth centered ±30kHz from the center frequency. The first and second alternate channels are defined as a 30kHz bandwidth centered ±60kHz and ±90kHz, respectively, from the center frequency.

Finally, phase noise, or incidental FM, is the amount of frequency fluctuation accompanying the positive and negative deviations of the modulated waveform. Incidental FM directly correlates to modulation quality. Although it is not defined in the CDPD system specification, incidental FM is a useful method for predicting impending component failure. For example, high incidental FM can be caused by high oscillator phase noise (which is defined in the specification) or GMSK modulator distortion, both of which can be detected by measuring incidental FM.

▶ Receiver Tests — The receiver tests required of a CDPD system are similar to those employed in testing an AMPS system, with some additions and modifications. Receiver sensitivity is the minimum RF power level at which the receiver block error rate (BLER) is equal to or less than 5%. This measurement verifies that the MDBS has the sensitivity to adequately receive weak signals from a distant MES. Power level is set, at the antenna input terminals, at a nominal frequency, and BLER is based on results from a Reed-Solomon error-correction decoder and is calculated as:

$$BLER = \frac{N - C}{N}$$

where

N = the number of blocks sent and

C =correctable blocks received.

Forward-channel control flag performance ensures that the MDBS is generating the correct decode status and busy/idle bits



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in the forward-channel stream. These bits are collectively called the control flag. Busy/ idle performance measures the specific RF levels at which the MDBS sets the busy flag. An iterative measurement technique is used to find the RF levels at which setting and resetting occurs.

➤ Sniffer Receiver Tests — As discussed earlier, some service providers use the sniffer and hopping configuration to implement CDPD. Consequently, proper functioning of the sniffer receiver is imperative if the CDPD system is to perform acceptably. Two tests, sniffer threshold and sniffer activation time, are performed to assess this performance.

Sniffer threshold testing measures the RF-received signal strength required to cause the MDBS to shut down its transmitter and move to another channel (if available) when AMPS voice traffic is detected. The interval between the sniffer's detection of AMPS traffic and when the CDPD transmitter is shut down is called sniffer activation time. System Specification 1.1 requires this interval to be less than 40ms after voice traffic is assigned to the channel. If the CDPD transmitter takes longer than this to shut down, AMPS voice channels will experience interference.

In addition to these RF measurements, a host of protocol-based measurements determine the ability of the base station to per-

Protocol-based measurements... along with RF tests, can completely characterize the performance of a CDPD base station.

form the proper operations in conjunction with the mobile terminal. These measurements, along with RF tests, can completely characterize the performance of a CDPD base station.

Instruments are now available that perform these measurements. Because of the nature of the service environment, test equipment manufacturers originally chose not to incorporate both RF and protocol

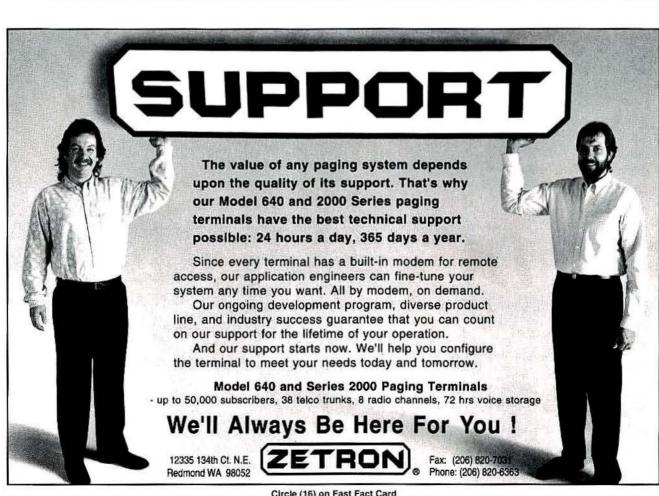
measurement capabilities in a single instrument. Potential users of these instruments do not always need to make both RF and protocol measurements, but rather one or the other. This scenario is likely to continue in the future, with test and measurement advancements coming in areas such as speed, automation and integration with other instruments via a network.

Summary

CDPD, as a complementary service to AMPS, has the potential to degrade the performance of the system to which it is attached. Properly functioning RF components and subsystems can reduce this possibility, especially when the sniffing-andhopping mode of operation has been chosen by the service provider.

Service providers who have chosen the dedicated-channel method of operation (who are growing in number) still must ensure that the RF performance of their CDPD system does not degrade the performance of the host AMPS system in terms of adjacent and alternate channel interference and other parameters. As a result, periodic monitoring of RF performance remains a necessity.





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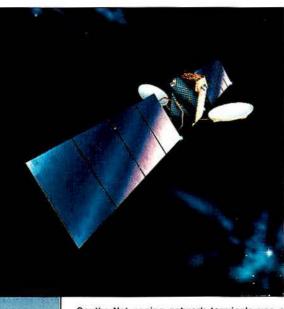
by Vaughn Entwistle

The adoption of TNPP (Telocator Network Paging Protocol) was a big step forward for the radio paging industry.

Using TNPP, independent paging providers can link up with other providers using telephone lines to create networks that greatly extend their coverage, while keeping costs to a minimum. Page One and SoutherNet are two paging networks taking advantage of this protocol. In 1996, Souther-Net began implementing a two-way satellite paging system using TNPP that promises to improve network reliability dramatically and to reduce operating costs. It also provides the potential of virtually unlimited coverage.

Paging networks

Typically, networks involve multiple



SoutherNet paging network terminals use a two-way link via satellite (above). Rooftop dish antennas (left) transmit and receive the information as TNPP packets.

paging terminals connected via telephone wirelines in a chain, ring or star configuration. A page can originate at any terminal in the network. As a TNPP packet passes from terminal to terminal along telephone lines, each terminal determines from the packet's header whether the packet is addressed to it. If so, it sends the appropriate pages to its transmitter(s). If not, it passes the packet on to the next terminal.

Of course, using this protocol requires a system equipped with TNPP-capable

paging terminals. Chuck Moffatt of B&M Communications, Tupelo, MS, (a member company of SoutherNet) said, "I would imagine that, between four of us SoutherNet members, there's over a hundred of those terminals in use, all of which are TNPP-capable."

When the chain breaks

There are, however, problems with the chain type of TNPP network, Moffatt said. "We have telephone company wirelines connecting terminal-to-terminal throughout the SoutherNet, but if the phone lines have a breakdown, the affected part of the network is put out of service. For example, if we had a phone line break in Chattanooga, TN, SoutherNet would be divided into two halves, and neither half could communicate with the other. Or, if someone lost a terminal, again, the network would be divided in two."

Two-way satellite paging

SoutherNet's solution to this problem is a form of radio paging in which all the terminals in a network are connected via a two-way satellite link, rather than through telephone wirelines. Moffatt said that this new way of networking has never been tried before. "Most people take wirelines, like Network USA, which carry pages to Pensacola (FL) where they uplink it to a satellite and receive the page at all their multiple locations. We've done away with the wirelines and gone all two-way. To my knowledge, no one else had tried it until we did."

Before two-way satellite paging could be implemented, a number of technical hurdles had to be overcome. In the end, the solution was arrived at through the

(continued on page 24)

Entwistle is the editor of Advantage magazine for Zetron, Redmond, WA.



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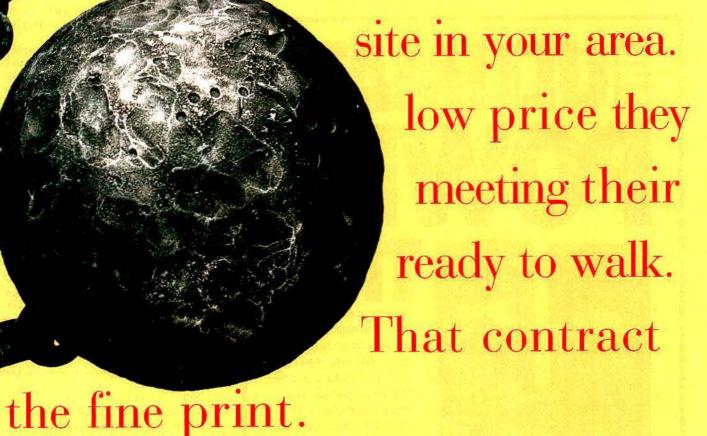
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(continued from page 20)

collaborative efforts of a number of parties, including SoutherNet member companies; Zetron, Redmond, WA; G.E. SpaceNet, Chicago; and NSN, Avon, CO.

TDMA VSAT networks

"NSN is a satellite services integrator and a broker of space time," said Todd Theel, director of data sales at NSN. "We have a TDMA VSAT network (timedivision, multiple-access; very small aperture terminal), which is typically used for credit card verification and point-ofsale, batch-type traffic. What NSN has done is to take that technology and apply it to the paging world to supply TNPP traffic connectivity. We call it "TNPPath," and we're using the system for terminal-to-terminal communications. What SoutherNet asked us to do was modify the system to do multi-TNPP inputs aggregated into a broadcast TNPP network."

TNPP for satellites

TNPP uses packets of information that are distributed among paging terminals in a network. A packet can contain the address of the destination paging terminal(s), information about the page itself, error-checking information and other elements necessary for communication. A paging terminal that receives a packet can tell which pages to transmit, which ones to pass along to other terminals in the network and what information (if any) has become corrupted.

Because it involves terminal-to-terminal communication through a satellite, rather than directly over wirelines, some unique problems had to be solved before TNPP would work in such a system.

"Each TNPP packet has a number," Moffatt said. "Each port on a TNPP card remembers the last 64 TNPP serial numbers. If it sees that serial number, it disregards it as being an illegal serial number (as if it bounced back from another terminal). In a network using telephone wirelines, the packets are given a new serial number as they are passed along, so there's no chance of that happening. On a satellite, however, there's no terminal to reserialize them."

After consulting with Zetron's technical support staff (Zetron played a major role in the TNPP development process), the SpaceNet designers' solution was to write a program that would take the packet, strip off the packet number and send it down in increments so that each packet could be given a new packet number.

NSN's Theel explained how the satellite system handles a page. "All the pages come into the terminals at the various SoutherNet sites. Then there's a link that takes it back-via satellite-to the hub in Chicago [which is owned by G.E. Space-Net]. The hub in Chicago takes the TNPP information from the 15 to 20 outlying sites, puts it all together and then puts it back out on the satellite so that it is broadcast, in effect, back out to all the sites.

"All the local information goes into the system, and what comes back is the combined network traffic. The system works very quickly. I think the average response time is two to three seconds," Theel said.

The satellite advantage

Moffatt said this new two-way satellite system has many advantages over wirelines. "With the satellite, if a terminal goes out, only that area is out of serv-



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Circle (21) on Fast Fact Card



ice. Plus, the satellite is faster. We have gobs of traffic on this thing, and we don't have collisions. We're carrying network traffic. We're carrying neighbor-to-neighbor traffic. We're carrying zone traffic. All this traffic is there, but if it doesn't pertain to us, the TNPP mapping in the Zetron model 2200 paging terminal throws it away."

Moffatt said that, in addition to avoiding network-crippling outages due to wireline breaks, the new two-way satellite system saves money. "For a four-way data circuit that crosses the Mississippi River, the phone company charges about \$2,500 a month. The satellite only costs about \$250 a month—quite a difference. There's a couple of places where a data circuit crossing the Smoky Mountains costs \$4,800 a month; so you can see, there's some tremendous savings to be gained."

Hardware

For a paging provider to participate in two-way satellite paging, the first requirement is a network running TNPP-capable paging terminals and an understanding of how TNPP works. The next requirement is the special hardware needed to link the paging terminal to the satellite, which is being provided to SoutherNet by NSN.

"We supply a VSAT, which typically consists of a 1.2-meter transmit antenna, a 200mW transceiver and an IDU (indoor unit)," said NSN's Theel. "The indoor unit is a small computer with a satellite transceiver working in Ku band and running on GSTAR 4. It's got complete coverage of the United States, so anybody could become a nationwide system overnight if they wanted to, and if they got the affiliates together."

SoutherNet goes satellite

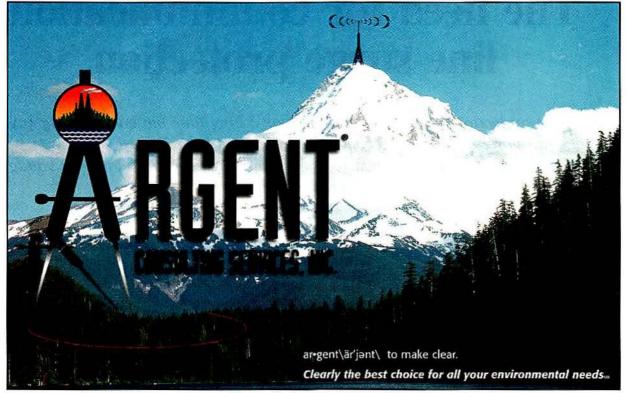
SoutherNet began implementing the two-way satellite system in early 1996.

"NSN wanted us to put in 20 satellite links within the first year," Moffatt said. "We've already got 15 installed or on order. When we get five more installed, our monthly rate will drop with each new site installed. As we add more links, our rate will come down even further, which is nice."

SoutherNet is committed to this new system, so it is requiring all potential new members to purchase their oven satellite receiver. "If you want to join SoutherNet," Moffatt said, "you will have to have four transmitters up-and-running, a TNPP-capable terminal and a satellite receiver. That's a sizable investment, but if someone is going to join us, they will have access to the whole system, so we want something in return."



DON'T LEAVE YOURSELF EXPOSED!...



New FCC Radio Frequency exposure guidelines effective January 1, 1997 require routine Maximum Permissible Exposure (MPE) evaluations. All transmitting facilities and devices regulated by the FCC are expected to be in compliance with the new RF radiation exposure guidelines. An Environmental Assessment is required for sites which fail to meet the guidelines. Any modifications necessary to achieve compliance with the new guidelines must be completed no later than September 1, 1997.

Argent Consulting Services, Inc. has developed a cost-effective procedure for determining compliance with the new exposure guidelines. Simply complete and return the following questionnaire. Argent will provide a certificate listing minimum distance requirements for controlled and uncontrolled environments along with a graph of exposure at various distances from the antenna. An information pack which includes the new FCC regulation is also available from Argent.

Our staff of professional engineers, environmental scientists, Extra Class amateur radio operators, General radio telephone technicians, and other qualified personnel also provide RF safety training and environmental assessments

	RF RA	ADIATION MPE EVA	LUATION QUESTIONNAIRE MRT497
Name of Licensee:		Renewal (Y/N):	Station transmit frequency (MHz):
Call Sign: Cl	ess of Station:		Emission Designator:
Antenna Location (Lat., Long. o	r UTM):		Highest transmitter RF output power (W):
Mailing Address:		-	Highest antenna gain use for that transmitter (dbi):
street/p.o. box			Line loss of highest gain antenna (dbi):
city sto	ite	<u>zip</u>	Type of antenna feed line:
Today's Date:	Phone	No.	(e.g. coax, hardline, openwire, direct end feed, waveguide)
☐ MPE Evaluation - \$75 ☐ Information Pack - \$10	☐ Check	☐ Money Order	Type of antenna: (e.g. dipole, vertical, beam, parabolic dish)
Send Check, Money Order or Credit Card to:	□ VISA		Height of antenna above ground (feet):
Argent Consulting Services, Inc. P.O. Box 19553	o se		Is this a directional antenna? Yes No
Houston, Texas 77224-9553 Toll Free: 800-634-3947 Fax: 713-464-4080	Card No.	Exp. Date	If yes, what is the beam width (degrees)?
www.argentinc.com	Signature		

The need for communication line surge protection

Surge protection has been overlooked for a long time but cannot be ignored anymore. Data and telecom equipment must be protected by a surge suppressor that provides a fast response time and a precise clamping voltage.

By Fabrice Larmier

Data equipment is extremely vulnerable to voltage surges and transients. Remote terminal units (RTUs), system control and data acquisition (SCADA) systems, demand recording meters and other telemetry equipment are particularly sensitive to transients, surges and overvoltages.

A single integrated-circuit (IC) package can contain more than 100,000 memory bits and more than 5,000 logic gates. The high sensitivity of the chips used in these packages makes them prone to fast degradation because of overvoltages. Their small size has considerably lowered their failure threshold. Private branch exchanges (PBXs), modems and telemetry equipment run on sensitive, low-voltage lines. Transistor-transistor logic (TTL) drivers for RS-232 circuits will fail when exposed to impulses ranging from 40V to 100V, in the same manner that complementary metal-oxide semiconductor (CMOS) chips will fail between 17V and 30V.

Tracking the transients

In general, most ICs fail at transient energies—below 100µJ. Chips that do not fail immediately will prematurely age and degrade. The effects of transients can be observed on ICs as thin, white lines between the input resistors and the input transistor contacts. Consequences may be severe—burnt line cards, lockups, memory loss, data retrieval problems, altered data and garbling. All of these baneful effects are often overlooked by users, who will first think of a hardware problem or a power-related problem when

Larmier is vice president of marketing for Citel, Miami.

troubleshooting a malfunction.

Power lines are generally well-recognized as a source of transients; however, too often the "back door" of communication lines is forgotten. Any equipment has an imaginary "circle" around it that can be broken in two ways: through the power line or through the communication line (telephone lines, leased lines, coaxial lines, RS-232 lines, RS-422 and RS-423 lines, and 4mA-20mA current-loop cables).

Sources of surges are numerous, but the most-common and most well-known source is a lightning strike, which will affect, by induction, all nearby data lines. Industrial transients are also significant,

Primary protectors have been designed to protect the operators, not the equipment.

They are man-made disturbances, mainly caused by start-up, switching and disturbances generated within the commutating systems of electric motors. Data lines will also suffer from magnetic and electrostatic inductions from nearby power lines.

Telco primary protectors, such as carbon blocks and gas tubes, inadequately protect data lines. The firing voltage of these devices is too high; therefore, they let through too many unwanted surges. Also, their response time is too slow to catch a fast-rising surge before it enters the equipment. These devices have been designed to protect the operators, not the equipment.

Data and telecom equipment must be protected by a surge suppressor that provides a fast response time and a precise clamping voltage with respect to the data equipment being protected.

We have designed fast-acting, lowclamping, high-discharge hybrid circuitry to divert to ground all damaging transient voltages while being transplanted on line. This hybrid circuitry comprises a threeelement gas tube on the input stage and a solid-state diode on the output stage. Gas tubes in our designs provide highdischarge capacity (>5,000A).

In spite of the possible existence of a primary protector, a gas tube in the secondary data protector is still needed. Once the surge passes the primary protector without being stopped, it will be clamped by the diode first, and then 99% of the energy will be handled by the gas tube. If there were no gas tubes in the secondary protector, the diode would "fry," and the user would be regularly subject to downtime for troubleshooting and replacement.

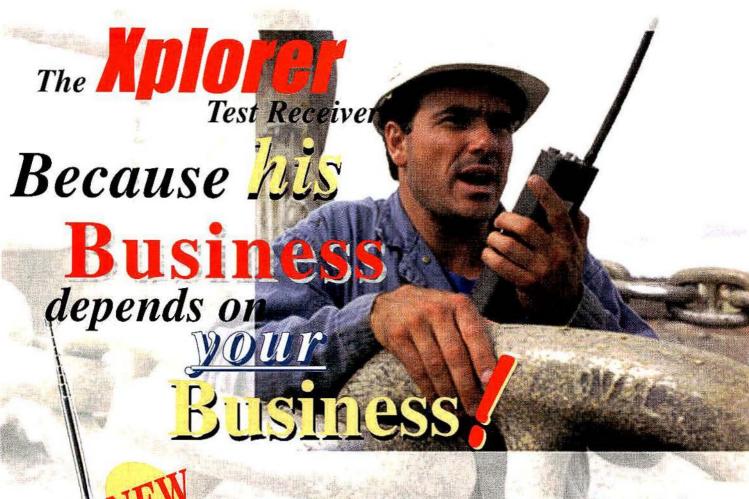
Diodes in our designs provide a response time of less than lns. As mentioned above, the diode itself will dissipate only 1% of the total energy. Therefore, resistors are used in series to prevent the diode from clamping the primary protection, which would cause the diode to take all of the follow-on current.

Locating protection

The placement of data circuit surge protectors is as important as their components. Every building entrance must be protected, particularly in a campus environment. In addition to entrance protection, terminals and other equipment should be protected if they are more than 500 feet from the entrance. In such a case, the ground for the protector should be the same ground used for the equipment.

Protection of data equipment must be thought of in terms of total protection: power lines and communication lines.





For Commercial and Mobile Radio testing, the Optoelectronics Xplorer stands alone. Let the Xplorer perform all your quick radio checks, instantly determining the radio's frequency, CTCSS, DCS, DTMF, deviation or signal strength. The Xplorer automatically locks on to any nearfield signal from 30MHz-2GHz in less than a second.

There is no setup necessary-Whether you're in the field or in the shop, the Xplorer is the portable, compact and economical solution for any two-way communications business.

FEATURES:

- Nearfield receiver, sweeps 30MHz-2GHz in <1 second
- Decodes CTCSS, DCS, and DTMF. Manually record tones into memory
- Lockout up to 1000 frequencies
- Store 500 frequencies in memory with time & date
- stamp, as well as number of hits per frequency
 •NMEA-0183 GPS interface for recording Latitude & Longitude coordinates (GPS Required)
- Numerical Deviation & Signal Strength bargraph
- VFO mode for tuning to specific frequencies
- PC Interface for downloading data from memory
- FM demodulation / Built-in speaker
- Auto or manual frequency hold
- Maximum nearfield reception / Up to 1/4 mile away

Communications Decoding

The Xplorer's 2 line LCD can selectively switch between CTCSS, DCS, and DTMF displays.



CTCSS Display



DCS Display



DTMF Display

Specifications

Frequency Range: 30MHz -2GHz Modulation: FM, Deviation < 100KHz Freq. Response: 50 - 3000Hz Auto Sweep Time: <1Second Input: 500hm, -59dBm @100MHz -25dBm @1GHz

Display: 2 line LCD w/ EL backlight Power: Internal NiCad Pack, 7.2V 850mA

Decoding Capabilities

CTCSS Tones: 52 DCS Codes: 106

DTMF characters: 16:1234567890*#ABCD

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IWCE show guide

Welcome to Mobile Radio Technology's pre-show coverage of the 1997 International Wireless Communications Expo. This section is designed to help you to plan your time at the Las Vegas Sands Convention Center, April 22–24. Sections include:



☐ a list of companies that are participating in the new product announcement/introduction center at the show, along with a description of the products they are going to display. (See page 32.)

a pull-out map on page 32A, including a list of exhibitors and booth numbers.

☐ a summary of exhibitors' products and services on display begins on page 33. Exhibitors listed include those who submitted information as of press time. The names of exhibitors that are also advertisers in this issue are highlighted in blue ink. Page numbers indicating where you can find their respective advertising are also listed.

More than 300 mobile communications equipment manufacturers, distributors and service providers will convene at the Las Vegas Sands Convention Center. Products on display will include antennas, accessories, cellular items, data communications, lightning protection products, mobile and portable radios, paging equipment, tone signaling equipment, towers and other wireless-related items.

An RF technology pavilion is also included on the exhibit floor, featuring the latest in design elements and subcomponents. Symposia at Expo will cover mobile communications industry opportunities and technical topics (See right.)

Mobile Radio Technology will be in Booth 1161. See you at Expo!

IWCE schedule at-a-glance

Monday, April 21

7 a.m.-6 p.m. Registration Open

8 a.m.-5 p.m. RF Design Seminar Series

Tuesday, April 22

7 a.m.-5 p.m. Registration Open

8 a.m.-5 p.m. RF Design Seminar Series

8:30-9:45 a.m. Opening Session 10 a.m.-5 p.m. Exhibits Open

11 a.m.-12:15 p.m. Legislative and Regulatory Directions

Overcoming Market Barriers to Small Businesses

Opportunities for SMRs to Serve Public Safety Agencies

1-2:15 p.m. APCO 25 Standards Update

Using the Internet for Business Development

Telecommunications Reform—Business Ramifications

2:30-3:45 p.m. Doing Business With Public Safety Agencies

How Spectrum Refarming Affects Private Radio Electromagnetic Energy Awareness—FCC Guidelines

5-7 p.m. International Reception (Invitation Only)

Wednesday, April 23

7 a.m.-5 p.m. Registration Open

8 a.m.-5 p.m. RF Design Seminar Series

9-10:15 a.m. Selling Products to Other Countries

Washington Roundtable

Trunking for Community Repeaters and Private Carriers
Using Digital and Computer-based Test Equipment

Are Public Safety Standards for Politics or Product

Excellence?

10 a.m.-5 p.m. Exhibits Open

10:30-11:45 a.m. IMTA-Global Report on the Growth of Commercial

Trunked Radio

How the FCC Compliance and Information Bureau Serves

the Mobile Communications Industry Lightning Protection Techniques and Products

Reselling Paging

1-2:15 p.m. Global Standards: A Strategy Tool for Entering World

Markets FCC Open Forum

220MHz Systems Technician Recruiting and Training

Mobile Data: RF vs. CDPD

2:30-3:45 p.m. IMTA Technology Overview: A Sampler of What's

Available

Specialized Antennas for Public Systems Resolving RF Interference Problems Building or Expanding Your Paging Netwo

Building or Expanding Your Paging Network

FCC Open Forum (continued)

Thursday, April 24

7 a.m.-1 p.m. Registration Open 9 a.m.-1 p.m. Exhibits Open

9-10:15 a.m. Tower & Site Acquisition and Management

Wireless Local Loop

Upcoming Paging Technologies

Telecom Scams

10:30-11:45 a.m. Closing Session: Taking Control of Your Destiny

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If you're a typical user, you can talk longer during an 8 hour work shift. Plus, Motorola premium grade batteries deliver up to twice the number of charge and discharge cycles than standard grade batteries. Which gives you

Lower battery cost per hour

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For the full story and your copy of the test results give us a call us at 1-800-422-4210.

Or circle the bingo card in this issue. And be sure to visit us at IWCE booth 663.



Always specify genuine Motorola premium grade batteries.
There is a difference!







MOTOROLA

U.S. & Canada Aftermarket Products Division 1313 E. Algonquin Rd. Schaumburg, IL 60196

Symmetry Resource, Inc. 12/96 Motorola EPD Slow Cycle Life Performance Data

New product introduction center

The new product introduction center will be in booth 379. Following is a list of the companies that will be participating, as well as a description of the new products they will be displaying at the center.

Astra Microwave Products

AMPL offers transmitter cavity lowloss combiners, receiver multicouplers and duplexer for radio trunking systems and cellular systems. Transmitter combiners and receiver multicouplers are offered in a basic package of three cavity combiners and expandable to as many as 32 channels. The transmitter combiner, receiver multicoupler and duplexer is offered in a single package mounted on a 19" rack. This unit combines transmitter channels (3 to 32) into a common antenna and splits the received signals to feed (3 to 32) receivers. These are manufactured in the following frequency bands: 330MHz-370MHz; 400MHz-500MHz; 800MHz-960MHz.

Barnett Engineering

Barnett is introducing the FLX remote site, alarm fault monitor, which monitors and reports alarm conditions of all types, including digital, analog, RF power, totalizers and loss of events. The unit reports the alarm conditions on telephone, RS-232, mobile radio, cellular or pager.

Ceotronics

The company's lightweight vibration headsets are designed for applications in high-noise environments. The headset has noise-attenuating foam earplugs. Radio audio is literally vibrated into the user's head, providing clear communication in noisy work areas.

Hirschmann of America

The Hirschmann GPS-cellular dualband antenna is a microstrip antenna with a 26dB-gain, low-noise amplifier for the Global Positioning System (GPS) combined with a quarterwave antenna for the cellular and SMR bands, with a separate feed line for each band. Models provide cellular coverage for the American and European cellular bands in both magnetic or bolt-on configurations.

KAVIcomm International

The KV mobile features intelligent dis-

play with auto-dimmer and scrolling to view 240 alphanumeric characters. It stores in memory 10 voice and status calls plus five long text messages while unattended. The unit connects via an RS-232 port to a PC for automatic vehicle location (AVL)/dispatch base station, printer, and GPS. It is MPT 1327 trunked and FCC type-accepted. It will be shown with GPS.

The KV repeater and base station is a modular, 19" rack-mount, trunking and SCADA interface with 16 synthesized channels, isolated 600Ω input/output, 50W of power, CTCSS decoding and regeneration and mic talk-through.

System configurations are available from a one-channel system to multisite, wide-area networks. Features include voice and data capability, integrated dispatch and AVL/GPS system.

Midland USA

Midland will be introducing a mini wideband 25W mobile radio for business and industrial users. The multimode, VHF model 70-1337 (136MHz-174MHz) and UHF model 70-1527 (450MHz-470MHz) feature as many as 20 programmable channels, CTCSS, DCS, CS, 12.5kHz, 25kHz or 30kHz channel spacing; 5kHz, and 6.25kHz channel stepping; fast priority scanning. These military-spec mobiles fit under the dash, even in sub-compact vehicles.

Riser-Bond Instruments

Riser-Bond's model 1270 is a combination time domain reflectometer (TDR) designed for companies that use both twisted pair and coaxial cables. It features front-panel BNC and banana jack connectors. It also combines the sensitivity and length readability of coaxial TDRs with the multiple testing modes of twisted pair TDRs.

Samlex America

Samlex's low-profile base station power supply has a switch-mode design that is tested to comply with FCC standards for home or office use. There is 12A output current, and the unit is fully protected against short circuit, overload and over voltage. The unit is available with integrated radio cabinets.

Samsung Microwave Semiconductor

Samsung's CS-515101 is a highintercept, low-noise amplifier designed for wide-dynamic range receiver applications. Exceptional low-noise performance and low input VSWR can be achieved simultaneously with the use of low-cost SMT components to implement the inputmatching network.

The ES-517341 is a power amplifier designed specifically for CDMA requirements. Excellent performance can be achieved with the use of low-cost SMT components to implement the output-matching network.

Selectone

The ST-50 module is a rolling code, time domain, speech encryption device offering audio quality comparable to other devices on the market. Included in the ST-50 family of encryption modules is the ST-51 and ST-52. The ST-50 is the most secure, yet all three units offer over-theair programming and remote deactivation of lost or stolen radios.

STI-CO

STI-CO's "Bird-Dog" tuner/coupler for tracking and monitoring is a low-power transmitting coupler that is attached to the existing entertainment AM/FM antenna and connected to the broadcast radio. It couples a low-power transmitter (i.e. the "Bird-Dog") into the antenna, and still maintains the broadcast function for entertainment (AM/FM) use. The "Bird-Dog" is disguised as an AM/FM antenna "booster." It is available in VHF (ST-BD-150), mid-band (ST-BD-220) or UHF (ST-BD-450) and is field-tunable in all ranges.

Tad Radio of Canada

The TAD M10 mobile radio maintains all of the features of the M8, but it adds several features such as small size, 396-channel capability, data input port, display dimming, backlighting on controls, CTCSS and CDS tone signaling, built-in theft protection, selectable receiver sensitivity and busy-channel lockout on each channel.

Photocomm

The Uni-Solar Triple Junction Solar Electric Modules are low-cost, unbreakable solar modules that will perform at peak power—even when partially shaded. Two exclusive models, the US 32 and US 64, are designed for use in telecommunications operations.

Products, services

Information for listings and booth umbers is accurate as of press time nd is subject to change.

.W. Enterprises Booth 282 xisting Products Carrying cases for telecommunications porable equipment. New products_ 'arrying cases for IDEN and RAVEN series andsets in hard/soft leather and nylon. -Circle 201 -A.C./Data Systems Booth 344 Existing products Transient voltage surge suppression devices that use the modular Surge Blox. New products Surge protected energy center/transfer switch (SPECTX), a combined main disconnect (part of the manual transfer switch with walking beam mechanical interlock), with Surge Blox modules mounted on copper busbars and 40--position distribution center in a single 53.6"H 1×18.6 "W $\times 6.4$ "D panel. Circle 202 Advance Label & Tag Booth 1348 Existing products_ Nameplates and logos for pagers, phones and radios; specialized labels for antennas and barcodes; tamper-proof labels for batteries; label printing systems; pager repair labels. Circle 203 See classified ads foam dielectric cables; 901 series SMA brass Booth 124 connectors; 908 series MicroMate microminiature surface-mount coaxial connectors.

Advanced ElectroMagnetics Existing Products Anechoic material; microwave/radar absorber material. Circle 204 Aerotron-Repco Systems Booth 261 Existing products_ Radio frequency transmitters; receivers; RF modems; conventional and spread-spectrum OEM products; two-way base stations and repeaters. New products PTSM120 plug-in trunk for Radius mobiles; PTSP50 plug-in trunk for Radius portables; Idigital select board for Radius SM120; Basic 4 generic trunking logic board; Ultra 2 ge-

Booth 285 AF CommSupply Existing Products

neric trunking logic board.

Circle 205

Wireless equipment including base station and mobile antennas; cable and installation accessories; site equipment; test equipment; bench supplies and cellular accessories. New products_ Rugged, lightweight aluminum alloy cabinets for indoor and outdoor applications from DDB Unlimited; flexible, shielded, low-loss braided cable from Times LMR; lightning protection products from Andrew. Circle 206 See classified ads Booth 455 Air Comm Existing Products_ Mobile, portable, base station radios; tone and voice pagers (Motorola); accessories for each; CTS tone reeds/filters; digital code plugs; paging reeds/filters. New products_ Motorola Radius two-way radios. Circle 207 See classified ads Allen Telecom Group Booth 301 Existing Products_ Mobile and base station antennas; filter products; wireless test measurement equipment. Circle 208 Amphenol Communications Booth 879 Existing products SMA and SMB subminiature coaxial connectors; DIN 7/16 low intermodulation connectors; BNC, TNC, N, UHF, Mini-UHF and twin axial coaxial connectors; reverse polarity coaxial connectors. New products. TWB 500 braided flexible foam dielectric cables; TXL 50Ω corrugated superflexible

See ad page 45 Circle 209 **Amplifier Research** Booth 1271 New products 7551G4 model 75W amplifier 0.8GHz-4.2GHz. Circle 210 Anchor Graphics Booth 462 Existing products _ Pager labels; cellular phone labels. New products_ Code-a-label, a software package designed to print the back labels for pager (capcode, barcode and frequency).

Existing products _ Antennas and transmission lines; distributed communications systems-RF can be brought indoors; systems can be configured.

Circle 211

Andrew

See classified ads

Booth 309

Anritsu Wiltron Booth 466 Existing products_ MT 8801B communication test set; MS 2651A/2661A/2602A spectrum analyzers; MG 3670-series digital modulation signal generators; 69-series low-noise microwave signal services. New products_ CDMA signal generator; Site Master 5330A/ 5331A; MS2437A/2438A power meter. Circle 213 See ad page 17 Booth 449 Existing Products_ Mobile, base and portable antennas ranging from 26MHz to 2.4GHz New products_ Phantom mobile antennas; Voyager aluminum base antennas; wideband mobiles; Gamma enclosed yagi antennas; high-gain base antennas. See classified ads Circle 214 Booth 481 Antennaco Existing Products_ Directional, base station antennas (VHF, UHF, cellular, 2.4GHz); MicroCell antennas (cellular); power dividers. New products MicroCell antennas for 1.9GHz and 2.4GHz. Circle 215 Antennas America Booth 367 Existing Products Disguised decal mobile antennas for cellular, VHF/UHF, GSM/ETACS and GPS. New products Disguised decal mobile antennas for PCS. Circle 216 Associates Leasing Booth 565 Existing products Leasing and financing programs for buyers and/or end-users of all types of communications equipment-demo or rental equipment: municipal financing (SBA lender); leasing of sales/service vehicles. Circle 217 Booth 129 Astron Existing Products_ Power supplies; inverters; converters; battery chargers. New products_ Switching power supplies. Circle 218 See ad page 11

Sunmate solar electric generators; Desulfator

Atlantic Solar Products

battery maintenance products.

Existing Products_

New products_

Booth 468

Expo

Complete line Sunmate solar electric generators; Desulfator DS-500, DS-1000.

Circle 219

AVCOM of Virginia

Booth 1316

Existing Products

Portable spectrum analyzers (PSA-65B, PSA-65A, PSA-37D); RF and microwave sweep/signal generators (MSG-1000B, MSG-1750A); network and spectrum analyzers (NSA-1000A); return loss bridges; broadband noise generators; portable test receivers (PTR-

25D); microwave video links and RF/microwave accessories for the wireless industry. New products

PSA-65B with digital frequency lock (portable spectrum analyzer); PSA-70A microprocessor-based portable spectrum analyzer; PTR-25D portable test receiver; RLB-1300-50 50Ω return loss bridge.

Circle 220

See ad page 94

Avtec

Booth 655

Existing Products_

DSPatch series console systems—color touchscreen, mouse-operated integrated radio/telephone console systems capable of supporting from 32 to 1,024 lines or workstations. Features include conventional and trunked radio, multi-format paging, integral voting, ANI, speed-dialing, caller ID. Supports virtually all circuit types including T1/E1.

Circle 221 See ad page 56

Existing Produ	ucts	
Microwave rac	lios: model 1050 di	gital spre
spectrum; mod	lel AMLD 6GHz at	alog; mo
AMCD 6GHz	digital; model 102	7/1028 poi
to multipoint.		
New products		
6GHz digital radio.	spread-spectrum	microway

Barnett Engineering

Booth 1187

Booth 1

Existing Products_

Circle 222

Aydin Microwave

B1270 Protalk voice dial-out alarm reporting unit; B1225 ARU for transmitting alarms over mobile radio systems; B1474 radio modern allows the transmission of data over mobile and trunking; B1275 SPX monitors PLCs and sends messages over radio, pagers, PA systems.

New products

B1280 FLX remote site monitor/controller monitors and reports a combination of digital, analog. RF power, totalizers and loss-of-event conditions. Alarms can be reported and acknowledged over telephone lines, mobile radio systems, cellular telephones, RS232 and pagers.

Circle 223

BEE Electronics

Booth 437

Existing products_

Durus nylon two-way and pager cases; Glove leather cellular cases; heavy-duty leather twoway and pager cases.

New products

Line of cases to fit IDEN; hard leather, Durus and Glove leather cases to fit the Raven and the Powerphone.

Circle 224

See ad page 38

Bird Electronic

Booth 648

Existing products

Test equipment for RF power measurement and management in 50Ω , $50\text{kHz}{-}2,500\text{MHz}$ systems, including portable and panel-mount Thruline wattmeters, Termaline absorption wattmeters, antenna testers, line sections, coaxial terminations and attenuators and

accessories.

New products

AT-100 2MHz-136MHz antenna tester and AT-400 80MHz-520MHz antenna tester; 5201 series 12- and 24-channel meters; 2W-300W Termaline bidirectional dry loads and attenuators; APM-16 average-reading power meter for digital and analog RF.

Circle 225

See ad page 40

Alexander Advantage...



Alexander has been manufacturing batteries for the wireless industry for more than 30 years. We are dedicated to excellence, making the Alexander name the choice for quality and reliability.

We have world-class design and production facilities for both batteries and chargers. This gives you a single source for portable power and battery charging/conditioning for all your communications needs.

Superior quality and reliability result in longer battery life and lower cost per use.

With plants in the U.S. and England, Alexander serves a worldwide market for the wireless communications, medical, security, military, cellular, video and OEM applications.

Alexander -

- · ISO 9001 international quality certification
- Features a wide selection of cells from leading manufacturers, with choices in cell chemistry based on performance and price requirements
- Choice of chargers and conditioners which are precision-matched to the cells used and the customer's application
- · Nationwide customer service hotline and product selection assistance
- · OEM design and manufacturing services
- More than 30 patents covering a broad range of battery and battery charging technologies

Alexander



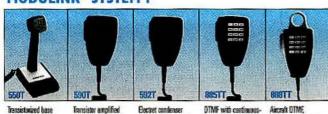
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noise-canceling and FAA certified

Shure ModuLink handheld microphones connect easily to virtually all popular radio transceivers with no hardwiring. Simply snap the correct cordset into the Modulink microphone and the transceiver. And in just 30 seconds, your customer is ready to roll.

Save service time and inventory costs while dramatically reducing downtime. Provide the sound quality and reliability you have come to expect from Shure. Best of all, you'll always have the microphones and cordsets to meet your customers' needs.

For more information on how you can make all the right connections with Shure ModuLink System 1, call 1-800-25-SHURE.



BK Radio (Bendix/King)

Booth 501

Existing products

E-series VHF and UHF portables and mobiles; dual transceiver mobiles; signaling devices; full line of accessories.

New products

UHF synthesized desktop base stations and repeater.

Circle 226

See ad page 95

Brown and Schwaninger Existing products_

Booth 965

"Form 600 Made Painless," computer software for preparation of FCC applications. Circle 227

Burndy Electrical

Booth 1441

Existing products Hyground; Hydent; installation tooling; all cellular and PCS grounding products.

New products

BCT500 battery crimp tool; Y500CT hand-held hydraulic tool; YSHG Hyground connector.

Cablewaye Systems

Booth 325

Existing products_

Flexwell loss foam coaxial cable; air dielectric cable; radiating cable; jumper assemblies; connectors and mounting accessories.

Circle 229

Cellular & Mobile International Booth 1161 Existing products_

Published monthly, Cellular & Mobile International provides decision-makers with articles that examine the technologies, applications and equipment of the international wireless communications industry. The circulation of 10,000+ reaches system operators, dealers, distributors, engineers, large-volume endusers (including public safety buyers) and manufacturers around the world, including Asian, European and Latin American markets,

Cellular Business

Booth 1161

Existing products

The first and only all-cellular trade publication for the cellular industry, Cellular Business is published 13 times a year for cellular system operators, dealers, retailers, resellers, sales agents, distributors, engineers, largevolume end-users and manufacturers. The editorial addresses both technological developments and marketing concerns, with columns focusing on news, new products, sales strategies and data. Visit our booth to pick up a copy and sign up for your free subscription.

Celwave

Booth 927

Existing products_

Base station antennas: 220-2; 440-2; 10204R; CELlite AP901011; AP906510; Optimizer ALE859012; Maximizer APU99014; AC905553; BDA/Microcell: 48522N; 48610; 220MHz paging system; filters; 911-PB4; 941-PB4; paging detector: 640910.

New products

Optimizer log periodic antenna ALE859012; Maximizer log periodic antenna PCS APL199014; Stationmaster II new broad bandwidth design. Circle 232

Central Tower

Booth 1255

Existing products

Guyed towers: self-supporting towers;

monopoles. Circle 233

Ceotronies

Booth 169

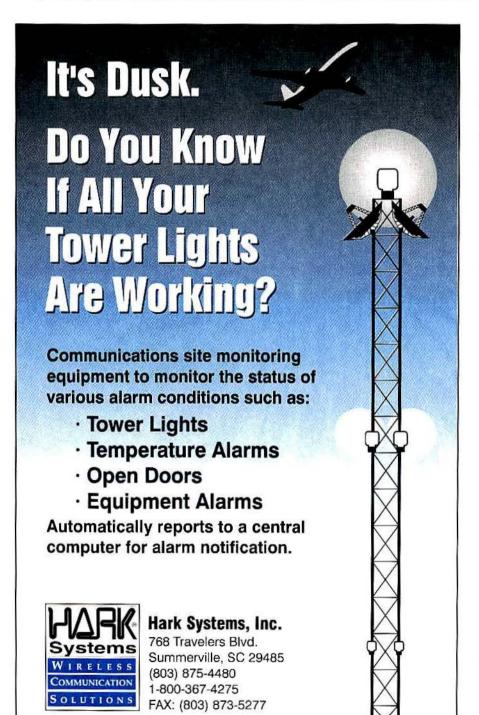
Existing products_

High-noise and lightweight PTT and VOX headsets; TC 917 UHF wireless headsets; Contact Com contact microphone for helmets and SCBA masks; covert audio systems; ear mic 475 and 575.

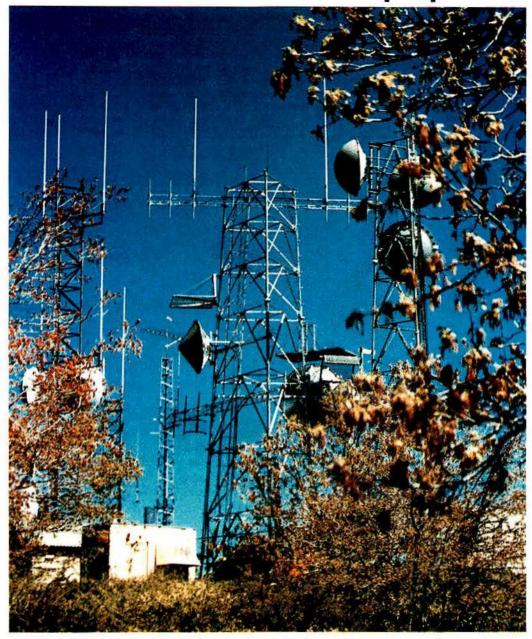
New products

Lightweight vibration headsets; wireless inductive receivers and covert systems; Man Down alarm adapter.

Circle 234



Your First Choice for Infrastructure Equipment



With 30 years experience in the wireless equipment distribution business, Hutton Communications is uniquely qualified to be your first choice for infrastructure equipment. Our eight strategically located warehouses provide fast and economical delivery of products from the industry's leading manufacturers.

With a single phone call you have access to a large inventory of base station antennas, cable, jumper assemblies, filter products, lightning protection, mounting hardware and power systems equipment from manufacturers such as Andrew, Celwave, Decibel, EMR, Polyphaser, Rohn, Siemens Solar, Sinclair, Telewave and Times. And we stock the test equipment you need for the installation and maintenance of your transmitter sites.

Get all your infrastructure equipment on one order from Hutton Communications, The First Choice in Wireless Distribution.



The First Choice in Wireless Distribution

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800-463-4793 FAX 888-312-4444 Chicago 800-435-9313 **Dallas** 800-442-3811 -AX 972-239-526 Denver 800-726-6245 AX 303-371-5690 Harrisburg 800-759-3031 FAX 717-763-9144 Seattle 800-426-2964 FAX 206-485-554 Toronto 800-265-8685 FAX 800-265-9414

Cerulean Technology Booth 1416 Existing products ClusterLink; SmartRoam; AVL. New products. PacketCluster Patrol. Circle 235 Booth 493

ChargeGuard Existing products

CHARGEGUARD automatic on/off timer switch for two-way radios, mobile computers and cellphones; SHOPWARE software database for the mobile communications industry. Circle 236 See classified ads

Cimarron Technologies Existing products

Booth 779

Skymark I GPS-based automatic vehicle location (AVL) systems. Supplied turnkey with complete hardware and base software with multiple map display features. Complete, fullfeatured GE-STAR, compatible ANI products and systems with IDEN, Man Down and Ra-

New products Skymark II GPS AVL system. Turnkey system includes enhanced AVL features, test data transmission, mobile status messaging and VehicleTracker GPS mapping software. Skymark II is a modular plug-in building

block system. Circle 237

CommScope

Booth 317

Existing products_

Cell Reach 50Ω broadband cables specifically designed for wireless transmission systems.

Communication Equipment Booth 1554 and Service (CESCO)

Existing Products

All types of products for tower sites: mounts; tower hardware; lighting; grounding; climbing equipment; safety equipment; tools; capstans; winches; gin poles.

Circle 238

Communications Data Services Booth 1215

Existing products

RF Engineering Tools: RFCAD, area coverage prediction software for Windows (Windows 3.1+, 95 and NT) provides multisite area propagation studies, FCC contours, point-topoint terrain and point-to-point propagation analyis for paging, cellular, SMR, PCS, land mobile and broadcast applications.

New products_

RFCAD 2.0 propagation software uses USGS topographic maps as base maps for RF analysis studies and can integrate international base maps and terrain data; upgrades to RFCAD 2.0.

Circle 239

See classified ads

Booth 880

Communications Product Development (CPDI)

Existing products

Prepaid wireless through CPDI's PC-based CALL control call processing platform—can be used for debit cards, international callback, voice mail, prepaid residential and prepaid Internet

Circle 240

Computer Resources

Booth 1144

Existing products

Sales and service management software; SMR billing software; pager billing and inventory software; accounting modules to interface with specialized billing software; MRIDA software.

Circle 241

Comtelco

Booth 554

Existing products

BSXL series base station antennas; Y22 series yagis; Y33 series yagis; classic series mobile antennas; mounts and accessories. New products

Y22198 1.9GHz yagi antennas; Y22248 2.4GHz yagi antennas.

Circle 242



New from BEE®

On Cases Available in Leather or Durus® Nylon

If you love the convenience of a belt clip on your portable, but hate the way plastic always seems to break... BEE® has a solution for you!

Introducing the first belt clip available on a top quality leather or nylon case. Our clip is

formed from heavy gauge, heat treated, powder coated spring steel and is securely riveted to the back of the case. You'll never have to worry about radio damage again.

GIVE US A BUZZ 1-800-336-3115



Durus'

Now your choice of three convenient ways to carry your radio case:

Our new spring steel belt clip mounted on the back of either leather or Durus* cases.

Our famous quick disconnect swivel option.

Regular snap down belt flap.

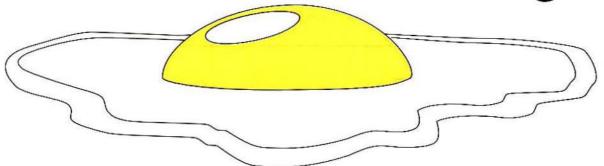


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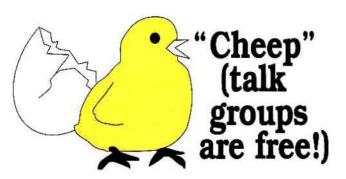


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SmartSTOR™ Can Unscramble Your Trunked Radio Recordings...



In Short Order.



The SmartSTORTM digital logging system is an extraordinary new way to record and selectively recall trunked transmissions. A patent-pending process unscrambles the jumble of conversations inherent on trunked channels and sorts them out for you. So now you can replay only the exact transmissions you want by date/time, channel, transmission type, talk group...even individual unit ID's...including "private calls" and telephone interconnects.

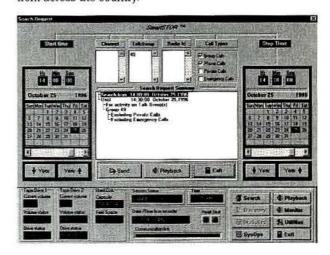
You also can do this in short order, usually in seconds. Just tell the SmartSTOR what you want to hear using its "People Server" search screen (example shown at right). SmartSTOR rapidly searches its data base for the transmissions that meet your request criteria and displays the result.



4133 Bluebonnet Drive • Stafford (Houston), TX 77477

FAX: (281)240-4323

Web: http://www.smartstor.com E-Mail: swift@neosoft.com When you see what you want, simply click on PLAY and you'll hear the transmissions in sequence. Selectable time compression eliminates dead spaces between the transmissions. Or you can monitor specific conversations in real time. Not only will SmartSTOR play your requests promptly, you can do it from your desktop PC, from across town, or from across the country.



SmartSTOR will unscramble your notions about the cost of recording your trunked system, too, because it won't crack your budget. You can get as many talk groups as you need at no extra charge. They're free. Plus your order will come with features, performance and flexibility you couldn't imagine with conventional recorders.

Ask, and we'll dish you up complete details. Swiftly.

(281)240-5885

See a demo at IWCE '97 booth 888.

Connect Systems

Booth 1221

Existing Products

Telephone interconnects; repeater tone panels; LTR system controllers; paging terminals and communications system decoders.

New products.

Models 8300D and 8300R.

Circle 243

See ad page 13

CPI Communications Existing Products_

Booth 361

Local extensions; de remote controls; de termination panels; tone remote controls and tone termination panels. Specialty remote control systems for use with Kenwood. Johnson, Midland and Motorola radios. Circle 244 See ad page 94

CRN Telemetry Devices

Booth 884

Existing Products_

Vehicle tracking and long-range alarm radio products; transmitters, receivers, decoders

and radio network products with extensive software for display and tracking of vehicles. Circle 245

CTI Products

Booth 742

Existing products

MCN comparator monitoring control network: TSAM transmitter steering audio matrix.

Circle 246

See ad page 78

Cushcraft

Booth 649

Existing products .

Fixed-site, fixed-subscriber, portable and mobile antennas for PCS, PCN and SMR applications, including wireless local loop. Antennas suitable for RAD/RASP and micro cellular configurations.

Circle 247

Daniels Electronics

Booth 467

Existing products

VHF, UHF, 800MHz, 900MHz radio modules for base stations, repeaters, rural telephones and ground-to-air systems.

New products

Microcomm digital voice and data multiplexers: paging interface cards for remote paging; hot/cold standby radio systems.

Circle 248

Data Express

Booth 269

Existing products_

Fleet management 2000 AVL software.

New products_

DE-2400G RF modem with GPS, DE-500 mobile status messenger, DE-2000 mobile data computer; pickup and delivery software. Circle 249

Dataradio

Booth 1310

New products Integra (new technology); T-System. Circle 250

Davicom Technologies

Booth 112

Existing products

A-15, A-45 and A-80 series of base station antennas; MC-1500, MC-4500, MC-8000 series of cavity multicouplers; BP and PR series of duplexers: HFC, CFC and CTC series of transmitter combiners.

New products

CAT. RDT and WDT fiber-glass collinear antennas; MAC 16/32 site monitoring system; MHA and LHA low-profile antennas. Circle 251

David Clark

Booth 643

Existing products_

Hands-free equipment; headsets; microphones: console, DTMF, ear, throat, mobile and portable; adapters and connectors; wire and cable/assemblies and connectors.

New products

Headset adapter for Motorola GP350 portable radios, model C60626 (PTT).

Circle 252

Medels How Available. **GETTING MAXIMUM**PERFORMANCE FROM

Bird's New Antenna Tester Eliminates The Guesswork!

EVERY INSTALLATIO

Installing and troubleshooting cellular and mobile radio antennas can be a guessing game. Undetected problems with connectors, cabling, antenna placement even glass characteristics — can drastically affect performance.

Bird's AT-800 rapidly tests any 806-960 MHz antenna. The self-contained RF source is preset for cellular bands. Or select your own frequency range. A 100-point scan of VSWR, Match Efficiency, or Return Loss is graphically displayed within a

second. A simulated analog meter speeds single frequency tuning, and field strength mode verifies hand-helds. PASS-FAIL testing, audible indicators, and numerous other features make it easy to be sure. And the AT-800 is remarkably easy-to-use.

With the AT-800, installers, engineers and technicians don't have to guess anymore. Contact Bird now for more details.



U.S. Headquarters:

Tel: 216-248-1200 Fox: 216-248-5426

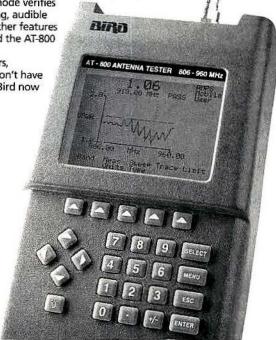
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Tel: 805-646-7255 Fax: 805-646-0275

Pan-Asian Sales Office: Tel: 65-2992537 Fax: 65-2998509

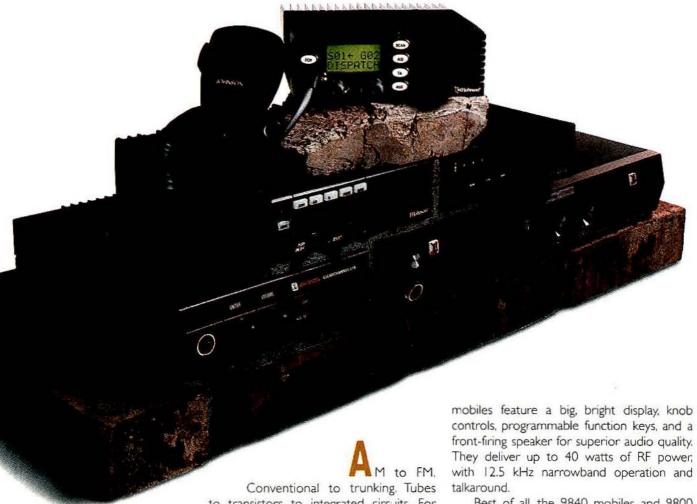
European Sales Office:

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Circle (35) on Fast Fact Card

We built our new mobile radio platform on a solid foundation.



to transistors to integrated circuits. For nearly 75 years, E.F. Johnson has built one new generation of radio technology on top of another. We've formed a solid foundation for new two-way radio products and systems—like our 9800 Series mobile radio platform.

In Waseca, Minnesota, we're building the first radios based on the 9800 platform. The 9840 UHF conventional/LTR® trunking

Best of all, the 9840 mobiles and 9800 platform give E.F. Johnson dealers a new, competitive stance in an increasingly tough wireless marketplace. Price, performance, and Waseca reliability make the 9840s and 9800 Series a product line for building to the future. Call us at 1-800-328-3911, or visit our web site at www.efjohnson.com.

INTELLIGENT CHOICES FOR A WIRELESS WORLD."



Delta Electronics Manufacturing Booth 1162

Existing products Broad-based line or RF coaxial connectors, including SMA, SMB, SMC, BNC, TNC, HN, LC-LT, MHV, 7/16 (DIN 47223) series connectors plus adapters.

New products

Catalog or 7/16 (DIN 47223) connectors. Circle 253

Diablo Communications

Booth 126

Existing products Operates 93 fully developed high- and lowelevation multi-user communication antenna sites throughout California, providing site rental space, site acquisitions, permitting, development, engineering, sales, marketing and management to the wireless industry.

Digital Wireless

Booth 128

Existing products Digistar digital trunked radio system with digital voice.

New products

Narrowband 12.5kHz secure digital radio; networked digital-voice trunked radio: Digistar digital mobile radio; Digistar singlechannel repeater; Digistar trunked repeater. Circle 255

Dinet

Existing products

Datamate MDTs models 400, 600, 1000, 1500, 3100; Dispatcher 1.0 software; Mapper 1.0 software.

New products

Mapper 2.0 software; Dispatcher 2.0 software; Truck Browser 1.0; DM500 AVL/GPS vehicle tracker

Circle 256

DTC Communications

Booth 337

Booth 375

New products

DynaPTX Wireless Diversity system has a modular diversity receiver designed for as many as five receiver/antenna modules. Circle 257

DuraComm

Booth 373

Existing products_

RM series modular power supplies; LP series desktop power supplies; PS series power supplies; TP series tone and voice pagers.

New products

RMB series modular power supplies; RMX series modular power supplies; DTB desktop power supplies with battery backup; SP series tone and voice pagers. See ad pages 64 & 112

DX Radio Systems/TPL Comm Booth 431

Existing products_

Paging systems; repeaters; trunking.

New products Millenium.

See ad page 103

Eagle Telecom International

Booth 928

Existing products

Telecommunication products, including power amplifiers/base stations; digital transmitter controllers; in-house paging terminals; security and remote control-based products.

EDX Engineering

Booth 243

Existing products

EDX SignalPro for Windows 95/NT; Signal, MSite; TPath; SHDMap; CVR; Rpath; MCS. New products

PCS/cellular system design add-on module; Microcell 3D ray-tracing add-on module.

See ad page 46 Booth 130

Electro-Comm Distribution

Existing products

Distributor of a full line of two-way radio accessories.

New products_

Highlights of the variety of products in stock for immediate delivery.

Circle 262

EMIR

Existing products ____

THE ADVANTAGE-PLUS ENCRYPTION SERIES!!

The Force, Digital Signal Processing can now be yours with the **ALL NEW ADVANTAGE-PLUS** Series from Selectone.

Selectone is proud to announce the ALL NEW ST-50 and ST-52 time domain encryption series.

The ADVANTAGE-PLUS Series offers the highest level of security second to none in the industry. The ST-50 & ST-52 have retained all the best state-of-the-art features and benefits

you've come to expect from Selectone!

These two ADVANTAGE-PLUS encryption products offer outstanding audio quality compared to other devices on the market today. They also offer four user-selectable-key variables. Each can be programmed to switch ON in CLEAR or encrypted mode. Each board has its own identity allowing over the air reprogramming and remote stunning of a lost or stolen unit. Now that's Selectone quality with all the bells and whistles!

Features & Benefits

- Highest Security offered
- Outstanding audio quality
- Miniature size
- Over the air programming
- Remote stunn
- ST-52 requires no export license
- Factory Installation available.
- Affordable

Call, fax or write today for details SELECTONE INC.

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When Every Second Counts, Rely On Orbacom's TDM-150 CRT-Based Console System For Your Critical Emergency Communications Needs



Easy-To-Use Primary Operating Screen. Resembles Traditional Radio Channel Modules; Control Modules, As Well As Other Displays, Can Be Adjusted To Meet Your Unique Dispatch Operation Conditions.

As an established leader in the industry, with decades of experience in the design and manufacture of sophisticated communications consoles, Orbacom is the name to trust for your community's critical emergency call and response situations. Orbacom's new generation of TDM-150 Communications Control Consoles is not only state-of-the-art, but also sets the stage for efficiently expediting your immediate emergency communications needs, as well as effectively fulfilling your ever-expanding future response requirements. Some outstanding features of Orbacom's TDM-150 include Multi-Level Trunking Interfaces, On-Line Screen Changes,

"Drag & Drop" Instant Screen Creation, Multi-Function Screen Grid, On-Screen Alarm Notifications, Windows™ Applications and many more user-friendly operations. The ultimate bottom line is that you and your community will appreciate knowing that when it comes to protecting life and property, you can depend on Orbacom's technology to help you transmit vital instructions, when every second counts. For more information, please call or fax in your request for free literature: 609-829-4455/fax:609-829-6980.

Circle (38) on Fast Fact Card

9-1-1

See us At IWCE, Booth #531.



Filter-ferrite/hybrid-ferrite combiners; receiver/tower-top multicouplers; bidirectional and unidirectional systems; mobile/base station/small format duplexers; isolators; I.M. panels; bandpass/pass-notch cavities; line taps.

See ad page 104

Enviro-Buildings

Booth 1253

Existing products Modular communication shelters; insulated equipment cabinets; retrofit shelters.

Eventide

Booth 104

Existing products VR204 four-channel digital audio logging recorder; VR240 eight- to 24-channel digital audio logging recorder; ECW-40 GPS chronometer for legal time reference.

New products

DIR-9-1-1 Call Check; ViewLog PC remote control for logging recorders; VR320 eightto 32-channel digital audio logging recorder. Circle 265

Fanon Courier

Booth 723

Existing products Courier: Procom M54 and MU54 5W, fourchannel capacity, crystal-controlled VHF and UHF portable receivers; Procom M510 and MU510 5W, 10-channel, synthesized programmable VHF and UHF portable transceivers. Fanon: megaphones; P.A. amplifiers; paging/talkback speakers; paging systems.

New products_

Courier: Procom M520 5W, 20-channel, programmable portable VHF transceivers; Procom MU520 5W, 20 channels, programmable portable UHF transceivers.

See classified ads

Fibrebond Booth 573

Existing products

GFRC communication shelters; communications equipment installation services; antenna towers.

New products

Extended-warranty program for shelters. Circle 267

Florida RF Labs

Booth 1371

Existing products_ Thin film-resistive products such as terminations, attenuators and power resistors; highreliability RF and microwave flexible, semiflexible and semi-rigid cable assemblies covering applications from dc to 40GHz.

New products_

High-power coaxial terminations; 12-4001SM; 12-4003TF; 12-4006NM; 12-4008BM; 12-3018NF; 12-3012SF; 12-3007SF; 12-3004TF; 12-3022SM; 123002SM; 12-3001SF.

Circle 268

Fryer's Site Guide

Booth 963

and Fryer's Data Services

Existing products_ Directory of tower sites for the U.S. coordinates. AGL's, AMSL's, contact names and phone numbers featured. Data services provides electronic data, 854 registration and more.

Circle 269

Futurecom Systems Group

Booth 1185

Existing products

Sitexcom wide-area coverage extenders; Mobexcom local-area vehicular repeaters; Chanexcom enclosed-area line amplifiers.

New products

CM800 series on-channel repeaters and translators; LA3B "smart" line amplifier; Mobexcom vehicular repeater. Circle 270

Gabriel Electronics

Booth 385

Existing products

Terrestrial microwave point-to-point antennas; transmission line systems; dry air pressurizers; installation services.

New products

Stealthwave technology products, environmental screens.

Circle 271

THE HUBER + SUHNER ADVANTAGE:

MANY VERSIONS AVAILABLE FROM STOCK!

- Handles currents up to 20 KA
- Operate to 12 GHz
- Low loss and VSWR
- Many interfaces & configurations



Protect your communication equipment

from lightning strikes with Huber+Suhner's

gas capsule and quarter wave shorting stub

EMP protectors. Grounding is achieved

outside the structure, away from the

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is as easy as loosening the cap for maintenance.

Huber+ Suhner's EMP protectors are available

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IT'S WHAT YOU DON'T SEE THAT MAKES OUR NEW CABLE BETTER



FAST, FAILSAFE CONNECTOR INSTALLATIONS

You won't see a trace of dielectric residue on our cables' center conductors. Amphenol's special dielectric pre-coat bond solidly holds the center conductor. Yet it peels cleanly to eliminate tedious scraping, accelerate connector installation and prevent performance robbing conductor damage.

MAXIMUM SYSTEM PERFORMANCE

TXL cable is totally compatible with your existing connector stocks. But combine it with TXL connectors and you won't see the high Intermodulation Distortion (IMD) you're probably experiencing today. Amphenol connectors offer exceptionally low IMD, typically -125 dBm (-168 dBc). And TXL cables' other performance

specifications meet or surpass virtually any other cable.

STRONG, FLEXIBLE AND WATER-TIGHT

Our cables' high compression strength closed cell foam dielectric is more resistant to water migration and much stronger than ordinary cable dielectric while delivering outstanding electrical performance, flexibility and long service life.

PRODUCTS AND SERVICE YOU CAN TRUST

Amphenol is renowned for building some of the world's finest RF connectors, but we're hardly newcomers to cable. TXL and TWB cables represent nearly a half-century's experience designing and manufacturing coaxial cables. Our ISO9000 Certified facilities produce millions of feet of cable per day.

Contact us today for a Free Transmission Line Solution Kit that explains all the advantages of TXL and TWB products.

Whether you're constructing a single radio site or a complete PCS system, you'll build it faster and better with Amphenol.

Amphenol°

Communication and Network Products Division One Kennedy Avenue Danbury, CT 06810
Tel: 203-743-9272 Fax: 203-796-2032 http://www.amphenol.com

CONNECT TO THE WORLD WITH AMPHENOL

Gamber-Johnson

Booth 721

Existing products

Complete mounting equipment for two-way radios; computers and other mobile communications. Mounting equipment fits virtually any type of vehicle.

New products

Keyboard support for pen-based computers used in mobile applications; NotePad is a universal notebook computer mount; MO-103, a portable notebook computer mounting system. Circle 272

Geotek Communications

Existing products

PC dispatch; EMW (enhanced mobile work-IMW (integrated station); mobile workstation).

New products

AVL software application to locate vehicles in a mobile fleet.

Circle 273

Glenavre

Existing products_

Booth 1113

Booth 579

Radio paging switches for one-way and twoway paging; microwave license-free radios; voice processing systems-the MVP modular voice processing systems; wireline extender technology-the GL6880; operational support systems; network management and RF planning solutions.

New products_

Options; voice dialing on the MVP system; the LYNX.sc.

Circle 274

See ad page 53

Booth 579

GMSI

Existing products

4100 series mobile data terminals; dispatch office computer terminals.

New products

"Target" software package: dispatch module, automatic vehicle location (AVL) module, vehicle tracking module.

Circle 275

Hark Systems

Booth 971

Existing products.

SMR single site enhancements and networking solution; tower site monitoring equipment with keyless access option; paging options include TNPP network controller and alphanumeric port expander; rotary to DTMF for international market.

New products

TSM 2000/C card access system with keyless access, detail log of all activity and remote buzz-in capability.

Circle 276

See ad page 36

Hewlett-Packard Existing products

Booth 943

HP8924C CDMA mobile test system; HP8920A RF comm test set; HP8921A option 600 CDMA cell site test set; HP8648A synthesized signal generator; HP83236B PCS interface.

New products_

ESA-L1500A spectrum analyzer.

Circle 277

See ad page 57

Booth 460

Hirschmann of America

Existing products Mobile antennas: 30MHz-960MHz, 1.8GHz; base station antennas: 800MHz, 900MHz, 1.8GHz.

New products_

Integrated bumper cellular antenna; GPS/cellular antenna.

Circle 278

See ad page 107

Hughey & Phillips

New products

Booth 660

Flashguard 3000 dual-aircraft warning obstruction light. Circle 279

Hustler Antenna

Booth 1415

Existing products G, G5, G6, G7 UHF/VHF base station antennas; Spirit series multiple-gain VHF/UHF/ 800MHz-900MHz antennas; yagi antennasserver environment, 10dB gain, 800MHz/ 900MHz, mag-mount UHF/VHF/800MHz-

EDX SignalPro: When You Demand a

Full-Featured System Planning Tool for Your PC.



Windows 95/NT GUI increases functionality and makes EDX SignalPro simple and intuitive to use. even in the field on a notebook

features or performance, you'll want EDX SignalPro™ This The Microcell 3D comprehensive tool for wireless Ray-Tracing Module system design takes PCs where teatures innovative they've never gone before. propagation Designed from the ground up modeling capabilities that are

to take advantage of 32-bit Windows® 95/NT, EDX SignalPro is a breakthrough software package that brings the features of workstation-based planning tools to your PC.

Unlike cellular-only planning tools, EDX SignalPro offers the most advanced propagation models available to predict performance for both area-wide and point-to-point link systems. The tool can be used for a vast assortment of one-way, two-way and wireless local loop systems operating in the 30 MHz to 40 GHz frequency range (up to 100 GHz with the optional Microcell 3D Ray-Tracing Module).

The powerful capabilities of the standard EDX SignalPro package are enhanced with two specialized optional modules. With the

PCS/Cellular System Design Module you can do system layout, frequency planning and performance analysis for AMPS. GSM and CDMA systems. The Microcell 3D Ray-Tracing Module offers leading-edge capabilities for indoor and outdoor digital system design using signal strength and time dispersion analysis.

EDX SignalPro for Windows 95/NT is the latest achievement in a long line of firsts from EDX Engineering-for more than 11 years a pioneer in the field of communication engineering software.

Contact us today for more information on EDX SignalPro.

EDX Engineering

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web: http://www.edx.com/ P.O. Box 1547 Eugene, Oregon 97440 USA

IWCE '97

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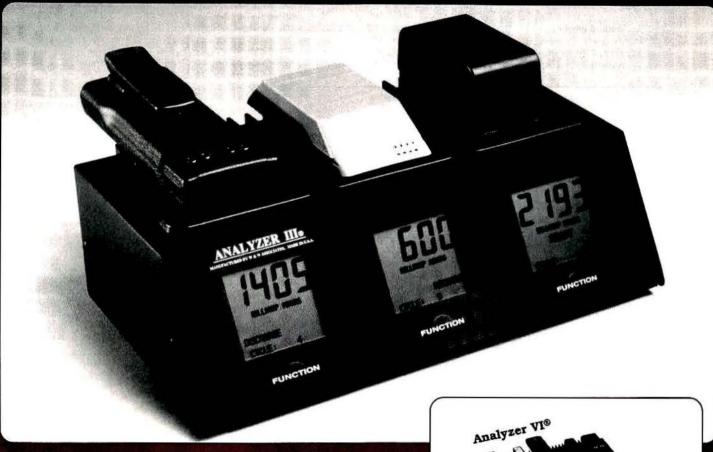
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April 22 -24 Sands Convention Center Las Vegas, NV

Booth #243

Introducing A New Generation of Battery Analyzers & Conditioners



W & W Associates introduces a professional and affordable BATTERY MAINTENANCE SYSTEM, the Analyzer III® and the Analyzer VI®. This new series of Battery Maintenance Analyzers offers features that CAN NOT be found on others that cost more than three times as much.

Charges and Analyzes: Nickel-Cadmium, Nickel Metal Hydride, Lead Acid and certain Lithium Ion chemistries. Will automatically identify Batteries with open cells, shorted cells, Batteries with reversed cells and Batteries that no longer meet minimum capacity levels.

The Analyzer III® and Analyzer VI® have features that are standard...Not available on others at any price.

- SINGLE BUTTON OPERATION: Initiates all modes of operation. These units are Totally User Friendly.
- FOUR INDEPENDENT CHARGE RATES: 300, 600, 700 and 1,000 mA.
- EIGHT INDEPENDENT DISCHARGE RATES: 200, 300, 400, 500, 700, 800, 900 and 1,000 mA.
- ADAPTOR CUPS: Completely interchangeable, requiring No Tools.
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E-Mail: w-wassoc@ix.netcom.com • Web Site: http//www.wwassociates.com

Analyzer 10

900MHz mobile antennas.

New products

Economical utility yagi antenna, 10dB, 800MHz/900MHz; Motorola-type mobile antenna mount; UHF/VHF hole-mount mobile antennas.

Circle 280

See ad page 89

Hutton Communications Existing products_

Booth 1227

National distributor of more than 100 wireless communications product lines from eight strategically located warehouses throughout North America.

Circle 281

See ad page 37

Booth 217

ICOM America Existing products

Line of land mobile communications equipment, including VHF/UHF mobiles and portables, single-sideband transceivers, repeaters and general coverage receivers.

New products

ICOM IC-F3, IC-F4, IC-F1020B, IC-F35, IC-

F45, IC-F1500, IC-F2500 multimode radios 12.5/25kHz; Smart Trunk II; Transcrypt scramblers available installed. Circle 282

IDA

Booth 511

Existing products

Trakit automatic vehicle location system; model RLC/LTI trunking controllers with cross busy, super 99-channel trunking remote controllers; Net-Link MP networking system; DTMF mics; conventional remotes and interconnects.

New products

Trakit automatic vehicle location system; Net-Link MP high-capacity dispatch networking; model 24-66 tone remote with alphanumeric display.

Circle 283

IFR Systems

Booth 764

Existing products_

Communications service monitors for twoway, trunking, paging and cellular testing applications (models COM-120B, FM/AM-1200 Super S, IFR-1900 CSA); spectrum analyzer.

New products.

Paging encoder option for Flex/Golay/NEC D3 digital protocols; service monitor for testing advanced digital IS-136 PCS.

Circle 284

See ad page 67

Ilsung Micro

Booth 1248

Existing products_ Mobile communications base station antennas; combiners and other related components.

Circle 285

Inmetco

Booth 266

Existing products .

The recycling of spent NiCd and NiMH batteries; the cadmium is recovered and reused by battery manufacturers; the nickel and iron are recycled into a stainless-steel remelt alloy.

New products_ Inmetco has begun its own cadmium recovery with the installation of a \$5-million facility that is capable of processing more than 3,000 tons a year and can be expanded to 10,000 tons when nationwide collection programs are

more fully developed. Circle 286

IWL Communications

Booth 102

Existing products_

Rentals: coventional and trunking portables and repeaters; international systems: sales, engineering, integration and project

management. New products

Intellivox VDAD500 noise-attenuating vox headset; IWL rural subscriber two-line interface.

Circle 287

JB Communications

Booth 1352

Existing products

CB, cellular and two-way cable assemblies:

Anyone can deliver clarity



Only proACTIVE™ delivers clarity here

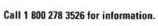


proACTIVE'

3500

Noise canceling microphones send a clear message. But what's more important is how clearly that message is received - no matter how noisy the workplace.

proACTIVE™ 3500 headsets use Active Noise Cancellation (ANC) technology to neutralize low frequency noise that interferes with the understanding of speech. Better understanding means reduced risk of accidents due to garbled, misunderstood instructions and warnings.



Noise Cancellation Technologies, Inc.

Find out what conventional headsets are missing.

One Dock Street Stamford CT 06902

Fax: 203 348 4106

http://www.nct-active.com

This radio will be very easy to install, even in the smaller cars and trucks!

And it has lots of programmable channels.



Good! It's wideband. That's a plus!

Just think of the business and industrial users that will want this radio!

The Secret Is Out!

Midland's New Mobile Radio
Receives Rave Reviews For Its
Leading-Edge Design, Rugged Good Looks
and Surprising Capability For The Price

How about the receiver specs and output power!

Wow! That priority scan is fast.

It's literally packed with built-in features and it's multi-mode, too!

Quality...Reliability... Versatility...Value They're all part of the bargain with Midland.

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antennas; connectors; mounts and accessories. New products "Extender" travel kits for Motorola flip series and GE/Ericsson phones; patented "FME" stud mount for mounting kits.

Circle 288

JBro Batteries

Booth 1143

Existing products

Complete line of replacement NiCd and NiMH rechargeable batteries for all land mobile radios; telepower conditioner/analyzers; battery maintenance systems.

New products_

JB 7147 rechargeable replacement battery for Motorola radio models MT 2000 and HT 1000 and a direct replacement for the Motorola NTN 7147 battery; JB 7394 and JB 7395 replacements for Motorola Visar radios. Circle 289

See ad page 24

JFW Industries

Existing products_

Booth 1460

Fixed attenuators; variable attenuators; pro-

Marquis Microwave Products, Inc.

Your Premier RF Manufacturing and Design Resource



10 - 2000 MHz

1 - 500 Watts

Class A/AB for Analog and Digital Systems

Low Profile Packages

100 % Duty Cycle

Featuring NEW High Reliability LD-MOS Technology



Model Shown: MMP300093020B28R1



★ Higher Efficiency

★ Lower IMD

* Proven Quality

Standard Product Line

30 - 50 MHz

72 - 76 MHz

136 - 174 MHz

280 - 320 MHz

406 - 512 MHz

Typical Specifications:

Frequency: 925 - 945 MHz Output Power: 300 W Input Power: 100 mW Voltage: 28 V Current: 30 A VSWR in/out:

2:1 max. Size: 19" W x 51/4" H x 161/2" D

Weight: 20 lbs

High Power Amplifier Models:

gh Power Amplifier Models:		850 - 869 MHz
Class AB	Class A	869 - 894 MHz
90 Watt	25 Watt	915 - 960 MHz
150 Watt	50 Watt	1850 - 1880 MHz
300 Watt	100 Watt	1930 - 1990 MHz
500 Watt		

Marquis welcomes your custom requirements

For more information call, fax or e-mail Marquis at

Marquis Microwave Products, Inc.

2155 Stonington Ave. Suite 216, Hoffman Estates, IL 60195 Phone: 847-519-2177 Fax: 847-519-2175 e-mail: sales@marquis-mwp.com Also visit our web site at http://www.marquis-mwp.com

Circle (45) on Fast Fact Card

grammable attenuators, RF switches and test systems.

New products

Non-programmable attenuators covering the 400MHz-2000MHz range.

Circle 290

E.F. Johnson

Booth 401

Existing products_

LTR trunking and conventional radio communication products and systems (for VHF, UHF, 800MHz and 900MHz) for SMR operations, business, industry, government and public safety.

New products

9840 UHF LTR/conventional mobiles with as much as 40W RF power, 12.5kHz narrowband operation; Model 2004 UHF repeater with as much as 100W RF power, 25kHz or 12.5kHz bandwidths, LRT trunking, community repeater and universal station options.

Circle 291

See ad page 41

Booth 787

Johnson Components

New products MMCX connector.

Circle 292

KAVIcomm International

Booth 984 Existing products.

KV-RP series repeaters/base stations; KV series mobile radios (trunked); KA series conventional radios; MPT 1327 system; GPS receivers; dispatch and AVL software; mobile printers.

New products_

KV-41T UHF trunked mobile; KV-16RP 50W repeater/base station.

Circle 293

Kenwood Communications

Booth 901

Existing products

TK-230/330 and TK-250/350 conventional portables; TK-630/730/830 conventional mobile products; TK-840/940, TK-930HD, TK-931HD, TK-353 and TK-430/431 trunking mobiles; base stations and repeaters; complete radio systems.

New products

TK-260/360 and TK-270/370 conventional portables; TK-762/862 and TK-760/860 conventional mobiles; multimode TK-250G/ 350G.

Circle 294

See ad page 55

King Communications U.S.A. Booth 1138

Existing products

KDT-5000 mobile data system; Win-Host messaging and RF control software; Flex/ MDT dispatch software.

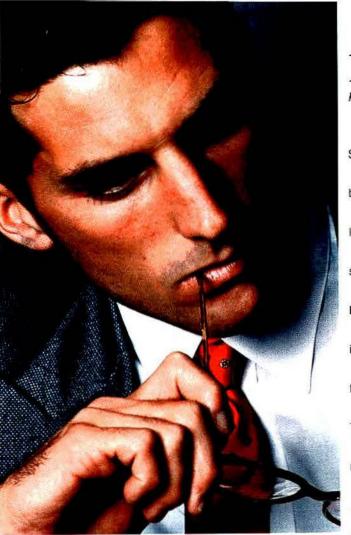
New products

Flex/AVL GPS/AVL system; Flex/CC credit card reader with on-the-air validation; Sceptor VHF, UHF, 800MHz/900MHz base/repeaters; Sentor site management; tower light controller; hot standby controller; RF monitoring. Circle 295 See page ad 25

Kyodo West Existing products_

Booth 113

50 Mobile Radio Technology April 1997



In Business, Talk Is Never Cheap

So we won't waste your time. You know how important two-way radios are to business. But, every business is different, and that makes decisions regarding leasing communications equipment critical. The Associates can help. Formed to service the complex financing needs of communications buyers and sellers, we know how important the right type of financing can be to the sale, delivery, installation and maintenance of equipment. Customers will benefit from lease and finance plans with no down payment, 24 hour approvals and locked in rates. The Associates also provides financing of SMR infrastructure equipment, inventory, rental and test equipment as well as SBA loans and vehicle fleet leasing.

But It Can Be Affordable

Funding your two-way radio communications system

through The Associates is your competitive advantage.

there's only one way to get the details. Call us at the

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http://www.theassociates.com



THE ASSOCIATES COMMUNICATIONS FINANCE GROUP

Full line of VHF/UHF land mobile communication products; mobiles; repeaters; base stations: control equipment.

Circle 296

Larsen Electronics

Booth 625

Existing products

A full line of mobile, portable and base station antennas for frequencies from 27MHz to 2.4GHz.

New products

3dB elevated-feed mirror-mount antenna; five-element, 10dB gain yagi; unity gain mini mag VHF and UHF antenna line; unity and 3dB gain radome omnidirectional antennas: NMO mount VHF wideband.

See ad page 77

Lease Acceptance

Booth 244

Existing products Lease financing for most communications equipment. Circle 298

Leavitt Communications

Booth 453

Existing products_

Motorola Pagers and related/associated items; Motorola Radius two-way radios.

New products_

Motorola eXpress Ultra pagers.

Circle 299

Lightning Eliminators

and Consultants Existing products_

Dissipation array system, custom-engineered; Chem-Rod grounding system; Spline Ball ionizer modular dissipation device.

New products

Sandwich Block direct buss technology surge Circle 300

LPKF CAD/CAM Systems

Booth 1375

Booth 1361

Booth 669

Existing products. Protomat series of Prototype circuit board fabrication systems.

New products

Protomat 915/VS.

Circle 301

Booth 1145 Lyncole XIT Grounding

Existing products

XIT grounding rod; clamp-on ground resistance tester model 3710; digital ground resistance tester model 4500.

Circle 302

M/A-COM

Existing products_

E-Series couplers, modulators and surface mount mixer; attenuators; combiners and dividers; isolators; amplifiers; surface mount synthesizers.

New products

MD54-005 MMIC mixer; AM50-0003 highdynamic range, low-noise amplifier; FR11-0001, FR11-0003, FR11-0004 drop-in ferrite products.

Circle 303

Marketronics

Booth 117

Existing products_

Motorola two-way radios; Tait MPT1327 trunking system; Andrew cable, connectors and accessories: Data Express AVL system; Glenayre digital line extender; data/voice multiplexing equipment for RF transmission; paging systems: GRE wireless modems.

Circle 304

Marconi Instruments

Existing products_

6200 series RF and microwave test sets; 2957 radio test sets; 2390 series spectrum analyzers; 2945A communications service monitors; 2050 series signal generators.

New products

CPM 20, 46 counter power meters.

Circle 305 See ad page 85

Maxon America

Booth 711

Booth 484

New products

MAX-8D 800MHz full-duplex trunking portable with Flip; trunking portable EP-4800 with dual-trunked operation; FRS-114 (fam-

THE DISPATCH & BUSINESS TELEPHONE Solution From RadioMate® **SWITCHMATE IITM**



- BOTH DIGITAL & Analog Equipment
- HANDS-FREE ACCESS WITH FOOTSWITCH & HEADSET.
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It seems we're into our blue period.

Western Multiplex is now known as Glenayre Western Multiplex.

Blue? That's just our new corporate color. Actually, we couldn't be happier. Because even though we've changed our name and all, life at Glenayre Western Multiplex goes on pretty much the same as always. Same great wireless interconnect products, same great customer service. Heck, give us a call at 408-542-5393 and you'll hear the same person answer the phone.



WESTERN MULTIPLEX

ily radio service) license-free UHF two-way radio.

Circle 306

See ad page 82

Maxrad

Booth 743

Existing products_ Low-band, high-band, UHF, 800MHz, SMR, cellular and PCS mobile antennas; GPSpassive and active antennas; aluminum and fiber-glass base-station antennas; aluminum and gold yagi antennas; mobile and base station antenna mounts.

New products

3dB, 4dB and 5dB fiberglass PCS base station antennas; MFB 19000 series; GPSA model active GPS antennas.

See ad page 65

Mentor Engineering

Booth 563

Existing products.

Express Plus mobile data system.

Circle 308

Circle 307

Meridian Communications

Booth 1407

Existing products_

Provides space and manages its high- and low-elevation community antenna site facilities

New products

Multi-user antenna sites in California, including Parsa Peak in San Diego county; the Chrysler building on Irvine Center Drive in Orange County: the Oxnard Financial Plaza on Esplanade Drive in Ventura County.

See ad page 15

Metric Systems

Booth 578

Existing products. Mavric 2000 (MAVPRI-0A1) multiport wireless circuit and IP transport services for telco bypass, SCADA and two-way data telemetry; Pathfinder Explorer 9600 (PATH-9600) UHF synthesized data transceiver, 403MHz-

512MHz, in seven sub-bands. New products_

Mavric Explorer (MAVEXPL-0V1) for fixed and specialized mobile integrated wireless data acquisition, control and AVL/GPS requirements; Mavric 5000 (MAV5000-0V1) wide-area wireless data hub and relay node; VHF Pathfinder Explorer 9600 (Path-VHF9600) VHF synthesized data transceiver, 132MHz-174MHz and 218MHz-280MHz. Circle 310

Microwave Data Systems

Booth 1423

Existing products.

Supplies full line of communications equipment: licensed and unlicensed point-tomultipoint and point-to-point radios for telemetry and voice applications; ISO-9001 registered.

New products.

Point-to-point system integration; SSTI/EI 2.4GHz spread-spectrum radio.

Circle 311

Microwave Tower

Booth 891

Existing products_

Antenna mounting components; coax mount-

ing accessories; cable tray systems.

New products_

ICECo coax accessories; cable tray systems for coaxial cable applications.

Circle 312

See ad page 83

Booth 618

Midian Electronics

Existing products_

Encoders/decoders; voice scramblers; remote control.

New products.

VPU-11, VPU-12 inversion scramblers; ANI-M; UD-1A, UD-1B, UED-1B.

Circle 313

See ad page 101

Midland USA

Booth 1101

Existing products_

10-0000 series Syn-Tech XTR; Syn-Tech II mobile radios, accessories; 70-0000 series Syn-Tech XTR desktop radios and accessories; 70-0000 series Base-Tech repeaters, base stations, options; 18-000 series mobile antennas 70-0000 series CTR and Syn-Tech II multimode mobile radios, accessories.



STI-CO's new totally disguised custom fender mount antennas with rugged stainless steel masts offer super bandwidths and a built-in ultra high efficiency AM/FM broadcast coupler.

The XXX-SB-150 Series has 24 MHz bandwidth (150-174 MHz), and the XXX-SB-450 Series has 67 MHz bandwidth [403-470 MHz].

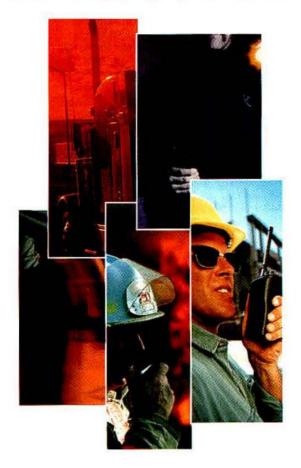
Of course, only STI-CO can provide exact AM/FM antenna replacements for all Chrysler, Ford, GM and many Euro-Asian body styles!

More supercolossal news from the . . .

DISGUISE GUYS



Whatever the



Joh...

KENWOOD ALWAYS COMES THROUGH.

Quality design and performance.
A versatile, affordable full line of two-way radio products.
The world turns to Kenwood for lifty years of engineering excellence, and the best in conventional and trunked mobile and portable radios. Used by public safety, government, business and industry throughout the U.S., Kenwood radios are built to demanding standards for dependable performance.

Your local Kenwood dealer can introduce you to the full line of Kenwood portables, mobiles, base stations, repeaters and accessories, as well as complete systems solutions.









KENWOOD COMMUNICATIONS CORPORATION • FAX (310) 761-8246 • http://www.kenwood.net

CALL 1-800-950-5005

New products_

220MHz linear modulation system mobile, portable radios; VHF linear modulation systems, mobile radios; 70-0000 series compact Business & Industrial, VHF and UHF mobile radios, accessories.

Circle 314

See ad page 49

Mobile Radio Technology

Existing products_

Booth 1161

Mobile Radio Technology is recognized as the leading source of technology-focused industry guidance. Readers include mobile radio dealers and service shops, large-volume endusers at public safety, government, transportation, business and industrial agencies, as well as paging and SMR service providers, and manufacturers and their reps and distributors. The editorial addresses the latest in

equipment and applications, business developments, legal and regulatory matters. Visit our booth to pick up a copy and sign up for your free subscription.

Circle 315

Multiplier Industries
Existing products ____

Existing products _

Booth 443

Batteries and accessories for two-way/PMR, cellular, GSM and PCS communications.

Circle 316 See ad page 61

MX-COM Booth 519

Fixed inversion voice scrambling boards for after-market application to mobile radios; five-tone encoder/decoder boards for fleet radio management; mixed signal integrated circuits for wireless voice; wireless data and telephony applications.

New products

MX589 4kbps-64kbps GMSK modem; MX429A 1200/2400bps MSK modem for trunked radio applications; MX818 lowpower fast CTCSS signal processor; MX828 CTCSS/DCS/SelCall signal processor; MX829 baseband signal processor for LMR/ PAMR/PMR trunked radios.

NCG/Comet Antennas

Booth 1451

Booth 1263

Existing products

Comet antenna line: VHF/UHF/900MHz/
1,900MHz/1,200MHz and 2,400MHz; highgain antennas; multiband antennas; mobile
antenna model FX-555NMO, which can transmit simultaneously on VHF, UHF and cellular
frequencies.

New products

Comet GP-24 2,400MHz base station antenna. Circle 318

Nearson

Existing products_

RF connectors; antennas; antenna accessories. Circle 319

Newmar

Booth 760

Existingproducts

Heavy-duty power supplies; battery chargers; dc to dc converters; dc U.P.S.; power racks and accessories; a multitude of inputs and outputs; common, isolated and spike-protected grounding.

New products_

Phase-three temperature compensated battery chargers—models: PT-15; PT-230-15; PT-30; PT-230-30; PT-24-15; PT-230-24-15; PT-45; PT-55.

Circle 320

See ad page 104

Noise Cancellation Technologies Booth 161

Existing products

Proactive ANR headsets.

Circle 321

See ad page 48

Northpoint Communications Products

Booth 479

Existing products ____

LoPro mobile antennas—low-profile design delivers gain in UHF, cellular and SMR frequencies.

Circle 322

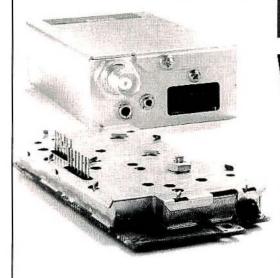
See ad page 102

NSI Communications

Booth 144

Existing products_

Radio communication equipment and systems: Alinco, Icom, Vertex, Motorola; acces-



For more information call 1-800-USA-1-USA

505 West Carmel Drive • Carmel, IN 46032 (317) 846-1201 • Fax (317) 846-4978

Email: ritron@ritron.com http://www.ritron.com

RITRON, INC.

Ritron RF Transceivers—The Wireless Connection

WIRELESS S O L U T I O N S

Synthesized, programmable RF transceivers for OEM and custom wireless data and voice applications. Utilizing the latest in SMD design and micro-processor technology, the DTX RF transceiver offers reliability and low-cost without sacrificing features and performance.

The DTX Series of RF transceivers includes a complete stand-alone module consisting of an RF transceiver and microcontroller-baseband module in an enclosure.

And for lower cost and highly integrated applications, where the user is prepared to supply RF synthesizer data and conditioned signals, the DTX RF transceiver board is available separately.

DTX Transceiver Standard Features:

- Low Cost
- Small Size (DTX module 1.24"H x 4.5"L x 2.5"D)
- · Synthesized, PC Programmable
- 2 or 5 Watt Output
- 11 Channel Capability
- CTCSS/DCS Signalling

USA

October 2, 1996.

Bob Jensen had a fire at his mobile radio repair shop.

He had only a few seconds to save things.

Thanks for the vote of confidence, Bob.

No offense, Fluffy, but the HP 8920A is irreplaceable, too. Because the HP 8920A service monitor provides the edge you need to survive in today's tough business environment. It offers

unmatched accuracy (frequency to within .1 ppm). MIL-STD ruggedization means it can withstand shock forces up to 30 g's, temperatures from 0 to 50 °C, and humidity from 0 to 95%. With the legendary reliability of HP (20,000 hrs mean time between failures). Most importantly, the 8920A service monitor offers superior expandability: it can test everything from two-way radios to pagers and cellular technologies. Which is important when you're building a business. Or rebuilding one, as the case may be.

Call 1-800-452-4844,* Ext. 5119. Talk to Charlie or one of our other experts about the HP 8920A and find out how you can get a \$2000 trade-in value for your old service monitor.

In Canada call 1-800-387-3154, program number TMU310. ©1997 Hewlett-Packard Co. TMSKD707/MRT Fluffy was not harmed in the making of this ad. She's as rambunctious as ever, and enjoying Bob's new location.



sories from wide range of manufacturers. Circle 323

Fred A. Nudd

Booth 465

Booth 745

Existing products

Monopoles; guyed towers; self-supporting towers and mounting hardware.

Circle 324

OptaPhone Systems

Existing products

OptaPhone FANwireless local loop; OptaPhone 2000 PLUS-2 dual-line radio telephone link.

New products

OptaPhone FAN; VHF band WLL systems. Circle 325

Optoelectronics

Booth 132

Existing products_

Frequency counters; CTCSS, DCS and DTMF decoders; test equipment; paging crystals calibration equipment.

New products

Xplorer Test Receiver: near-field test receiver with frequency, deviation, signal strength, CTCSS/DCS/DTMF and audio checks.

Circle 326

See ad page 29

Orbacom Systems

Booth 531

Existing products_

Communications consoles; cabinetry; CAD. See ad page 43 & 69

Otto Communications

Booth 564

Existing products V4000 series headsets; low-profile earphone

New products

Remote speaker microphone series; lightweight headset.

See ad page 16

Booth 986

Booth 438

Pace

Existing products MBT 250(A); ST 20A-SP; ST 40A-SP; ST 20-

TT; ST 60-SX; MBT 201; Multi-arm evac. New products

Programmable Thermoflo; Heat Wave. Circle 329

PanaVise Products

Booth 536 Existing products_

Cellular phone mounts: portable phone holders; mobile data terminal mounts; radio mounts; vehicle-specific phone mounts; speaker mounts.

New products

Portagrip 2000 cellular phone holder. Circle 330

Peiker Acustic

Existing products .

Microphones: desk mics; gooseneck mics; handmics; handsets.

Circle 331

Penta

Booth 179

Existing products

Color touchscreen communications consoles (dispatch).

New products

Console software: Windows 3.11, 95 and NT versions

Circle 332

Photocomm

Booth 922 Existing products_

Air-303 wind generators; Manpac portable military solar module; portable SunPak solar

module. New products

Uni-Solar's unbreakable triple-junction solar modules with shadow resistance and vandal resistance

Circle 333

Pipo Communications

Booth 754

Existing products.

DTMF encoders; high-speed signaling AE-1. Circle 334 See classified ads

PolyPhaser

Booth 223

Existing products_

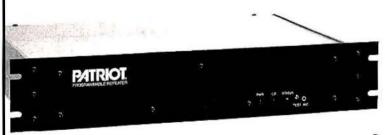
8PEP, 8PORT entrance panel; IS-IL 100A and 200A power mains protectors; IS-CF50HN;

IS-MR50LNZ and 15.

New products

LSC-13; IS-CL50LN; IS-MF50LD lightning

New Patriot Repeater Beats Kenwood TKR-820 In Laboratory Measurements and "Real World" Tests.



The complete line of Patriot two-way radios include synthesized, programmable portables and mobiles in the low band. VHF and UHF frequency bands.

Ritron, Inc. • 505 W. Carmel Drive • Carmel, IN 46032 • (317) 8464201

We pitted our Patriot RRX Series programmable repeater against some strong competition. Our "Real World" on-site performance tests confirm lab measurements that the RRX has less receiver desensitization and higher adjacent channel rejection than the Kenwood TKR-820. This means, with the Patriot, you get more reliable communications with greater range, and fewer lost calls due to interference.

But, superior performance and specifications are not the only things that separate the Patriot repeater from the competition. It can also costs hundreds of dollars less and still offer these versatile features/options:

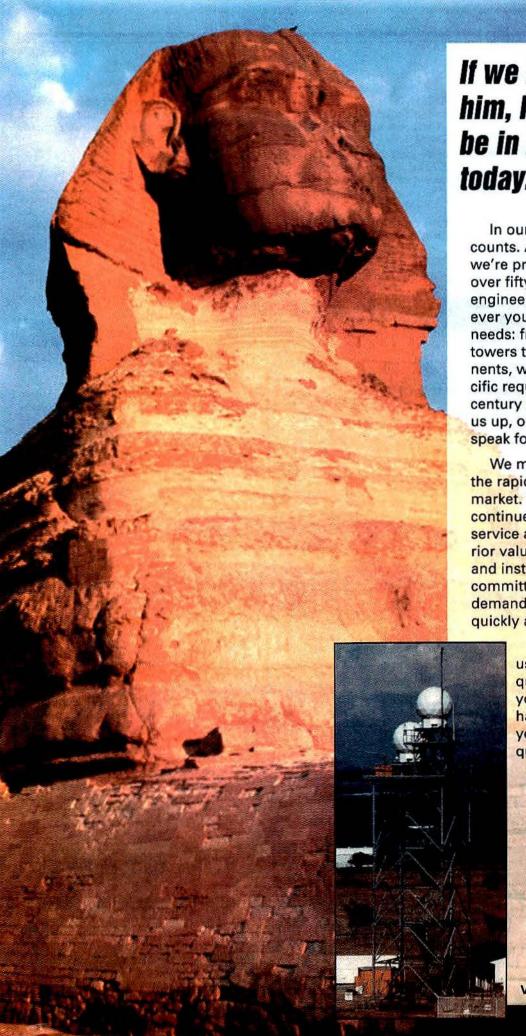
- 1-8 Watts or Optional 30 Watt Internal Amplifier
- · CTCSS or DCS Signalling
- Selectable Input Voltage 110/220 VAC, 50-60 Hz
- 12VDC Operation w/ Battery Charge and Auto Cut-Over
- Duplexer Delete Option
- One Year Warranty

BY RITRON

- · Plus a variety of Interface Modules that enhance the functionality of the RRX Series Repeater
- -Telephone Interconnect Module
- -4 Wire or 2 Wire Modules for Wireless Links
- -Telenexus -- Wireless Phone Line Extender

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protection and grounding solutions.

ad page 70

Powerwave Technologies Booth 255 Existing products

Streamlined SMR product line.

New products RF series PI0-05KI-C3-001.

Circle 336

Booth 483 **Primus Electronics**

Andrew cable; two-way communications products; antennas; PolyPhaser lightning protection; custom cable assemblies.

Circle 337

Professional Technology Systems Booth 113

Existing products

System integration specialists for worldwide applications.

Circle 338

Pulse Power Booth 268

Existing products_

Negative pulse micro-conditioning batterychanging systems for cellular telephones, camcorders and selected portable printers NiCd and NiMH. Circle 339

Radio Dealers Leasing

Booth 637

Existing products_

Leasing and financing programs for dealers, distributors, manufacturers and end-user customers nationwide. Customized programs available.

Circle 340

Booth 264 Raine

Existing products_

Nylon, "field tough" radio, phone and pager cases

Circle 342

See ad page 88

Relm Communications

Booth 601

Existing products.

Two-way crystal and synthesized mobile, portable and base radios; repeaters; base station components and subsystems; multiplexed antenna systems and IM suppression products. New products

MP32 and MP08 hand-held radios.

See ad page 21

RF Connector Div/ **RF** Industries

Booth 1360

Existing products

Expanded range of coaxial connectors, including BNCs, TNCs, Ns, UHFs, mini-UHF, MBs, SMAs, SMBs, 1/2" and 7/8" corrugated cable connectors; product line also includes cable assemblies, crimp tool kits, unidapt and celludapt universal adapter kits.

New products

7/16 din kits (RFA-4013); SMA kits (RSA-4027); MCX connectors (RFX-8000); FME connectors (RFE 6000 series).

Circle 345

RF Imaging and Communications Booth 662

Existing products. Motorola, IFR, Wavetek, Cushman, Hewlett-Packard, Stabilock, Marconi, Helper radio service monitors and general test equipment.

Circle 346

See classified ads

RF Neulink Division/ RF Industries

Booth 1370

Existing products.

Narrowband transceiver modems in VHF, UHF and 900MHz frequency bands; digital paging exciters in the VHF, UHF and 900MHz; products feature both synthesized and crystal-controlled frequencies.

New products

DPT-150-S synthesized 150MHz paging exciter; Neulink 9600V synthesized transceiver modems available in 150MHz, 220MHz and 280MHz frequencies; Skyline RTU(V) synthesized VHF SCADA modules.

Circle 347

RF Technology

Booth 378

Existing products_

Existing products

ht unt preamp. Performance 24 1 dB Gain Comp. Device Receive only Freq. Ranges (MHz) (dB) (dB) (dBm) Type

30-35, 35-40, 40-45, 45-50 30-35, 35-40, 40-45, 45-50 P30VDG, P35VDG, P40VDG, P45VDG < 0.5 GaAsFET \$109.95 26 DGFET P150VD, P160VD, P170VD 150-160, 160-170, 170-180 < 1.5 15 0 \$ 44.95 P150VDA, P160VDA, P170VDA P150VDG, P160VDG, P170VDG 150-160, 160-170, 170-180 150-160, 160-170, 170-180 < 1.1 15 0 DGFET \$ 56.95 + 12 < 0.5 \$109.95 24 GaAsFET P450VD, P460VD 450-460, 460-470 <1.8 Bipolar P450VDA, P460VDA 450-460, 460-470 <1.2 16 - 20 Bipolar \$ 74.95 P450VDG, P460VDG 450-460, 460-470 + 12 GaASFET \$109.95 < 0.5 16 P800VDG, P830VDG, P860VDG 800-830, 830-860, 860-890 < 0.6 GaAsFET Inline (rf switched) SP30VD, SP35VD, SP40VD, SP45VD 30-35, 35-40, 40-45, 45-50 15 0 DGFET \$ 74.95 <1.4 GaAsFET \$139.95 SP30VDG, SP36VDG, SP40VDG, SP45VDG 30-35, 35-40, 40-45, 45-50 < 0.55 + 12 150-160, 160-170, 170-180 150-160, 160-170, 170-180 150-160, 160-170, 170-180 SP150VD, SP160VD, SP170VD <1.6 15 0 DOFFT \$ 74.95 0 \$ 86.95 SP150VDA, SP160VDA, SP170VDA 15 DGFET + 12 SP150VDG, SP160VDG, SP170VDG < 0.55 GaAsFET <1.9 SP450VD, SP460VD 450-460, 460-470 15 - 20 Bipolar \$ 79.95 SP450VDA, SP460VDA 450-460, 460-470 - 20 16 Bloolar \$104.95 SP450VDG, SP460VDG 450-460, 460-470

Every preamplifier is precision aligned on ARR's Hewlett Packard HP8970A/HP346A state-of-the-art noise figure meter. RX only preamplifiers are for receive applications only. Inline preamplifiers are ri switched (for use with transceivers) and handle 25 watts transmitter power. Mount inline preamplifiers between transceiver and power amplifier for high power applications. System S/N improvement 6-14 dB typical. Other amateur,

Advanced Receiver Research

P30VD, P35VD, P40VD, P45VD

commercial and special preamplifiers available in the 1-1000 MHz range. Please include \$2 shipping in U.S. and Canada. C.O.D. orders add \$2. Air mail to foreign countries add 10%. Order your ARR RX only or inline preamplifier today and start hearing like never before!

0

+ 12

< 1.3 15 DGFET

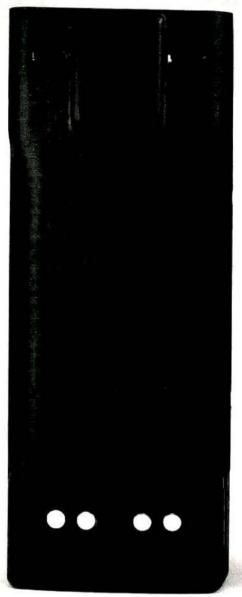
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The Eclipse series of base stations, repeaters, RF links and associated accessories.

New products

The "Dual," a low-power repeater, base station or link.

Circle 348

Riser-Bond Instruments

Booth 242

Existing products_

TDR cable fault locator model 1205T, model 1000 and model 1205C.

New products_

TDR model 1270. Circle 349

Ritron

Booth 615

Existing products.

Patriot two-way radios; synthesized, programmable portable radios, mobiles, repeaters; JOBCOM two-way radios: entry-level twoway radios, crystal, synthesized and programmable models; data telemetry products: RF data links, synthesized programmable (VHF, UHF, low band); wireless RTU (analog and digital I/O system with integral RTU and transceiver board).

New products

LTR trunking portables: RTX Plus 5W portable with DSP technology and enhanced features and capabilities, LCD and DTMF keypad, dualmode 12.5 narrowband and 25KHz in one unit; both VHF and UHF bands; LTR trunking portable: SST Plus, new 4W, fourchannel, ultra small portable, available in 12.5KHz narrowband or 25kHz channel spacing.

Circle 350

See ad page 56 & 58

Booth 237

Rohn

Existing products_

ROHN will display pictures of guyed towers, self-supporting towers, steel poles, concrete poles, equipment shelters and cabinets.

Circle 351

Ruf*Nek Building Systems

Existing products

Booth 1323

Series 300 fiberglass; series 600 concrete shelters; custom-built concrete and fiberglass equipment shelters; exterior and interior finishes can be customized from a basic interior to a multiroom building with back-up generator, automatic transfer switching, fire suppression system, equipment installation and environmentally controlled atmosphere.

New products_

Series 610 concrete cabinet with hidden path, "HP" HVAC distribution system with recessed supply air ducts that distribute conditioned air down in center of room. Return air is drawn from a lower area where heat dissipation exists, eliminating hot spots and poor air circulation.

Circle 352

Samlex America

Booth 1508

Existing products.

Samlex regulated power supply; SEC base station power supply; Samlex switch mode power supply.

New products

SEC 1212: regulated switch mode power supply; FCP 1000: cellular telephone power supply/charger; PSE 15012: dc-ac inverter; base station cabinets.

Circle 353

Samsung Microwave

Booth 685

Semiconductor Existing products

CS515101 low-noise amplifier; CS515003 voltage-variable attenuator; 60dB attenuator; CS516003 voltage-variable attenuator; 35dB attenuation.

New products

ES616101 broadband driver amplifier; ES515241 PCS medium-power amplifier; CD515342 PCS power amplifier; ES516241 ISM medium-power amplifier; CS516342 ISM power amplifier; ES517341 CDMA power amplifier; ES567385 CDMA power module; ES615001 voltage-variable attenuator; ES616001 voltage-variable attenuator;

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FS615441 ISM downconverter. Circle 354

Scala Electronic

Booth 1313

Existing products. Fixed-station antennas for indoor and outdoor requirements using spectrum in the two-way radio, trunking, UHF/VHF, cellular, PCS/ PCN, paging and point-to-point bands; coaxial cable and connectors from 3/8"-15/8". New products_

Dual-frequency omni antennas; flexible coaxial transmission line, in 3/8"-15/8" sizes; jumper cables in 1/2"-7/8" superflexible sizes; lightning arrestors/surge suppressors; new communication products catalog.

Circle 355

Booth 1201

Existing products_ 220MHz-222MHz radio products: 20W base station; 100W base station; repeaters; voiceonly and voice data mobiles; hand-held portable transceivers.

Circle 356

ServiceWare

Booth 590

Existing products

ServicePlus service management software.

New products_ ServicePlus series 2W; ServicePlus series 3. Circle 357

See ad page 110

Setcom

Booth 487

Existing products_

Vehicular intercom systems; headsets; communications accessories for police, fire, EMS and industrial use.

New products_

Master Station 920 aerial intercom; police motorcycle helmet comkit.

Circle 358

Sharp Communications

Booth 783

Existing products GE mobile communications; Telewave site equipment; Whelen warning and safety lights; Samlex power supplies; DDB cabinets; REI connectors.

New products

GE KPC 300 and 400 portables; DDB cabinets.

See classified ads Circle 359

Shure Brothers

Booth 737

Existing products.

Modulink family of interchangeable microphones and cordsets; base stations; hand-held and gooseneck microphones for two-way communications.

New products_

550TSB Modulink base station microphones for trunking and 220MHz radios.

See ad page 35

Sinclair Technologies

Booth 229

New products

Panel antennas; NPCS filter equipment; masthead amplifiers; "TM" series.

See ad page 71

Booth 979

Slattery Software

Existing products_

FCC licensing software; price quotation software.

New products.

Quickform 415 for new FCC form 415. Circle 362

Small Business

Booth 963

in Telecommunications (SBT)

Existing products.

Association for small businesses in all areas of telecommunications-if a company is not being heard because it is too small, it can join SBT.

Circle 363

SmartLink Development

Booth 1337

Existing products

SMRLink trunking and network system; SiteLink digital multiplexer. Circle 364

SmarTrunk Systems

Booth 249

Existing products

Smartrunk II radiotelephone trunking system.

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FEATURES INCLUDE:

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- **♦**Conventional or trunked radio
- ♦ANI with call queue
- **♦**Multi-format paging
- **♦Simultaneous** conferences
- ♦ Many more

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Circle (63) on Fast Fact Card

Expo

SMC Flectro-Mount

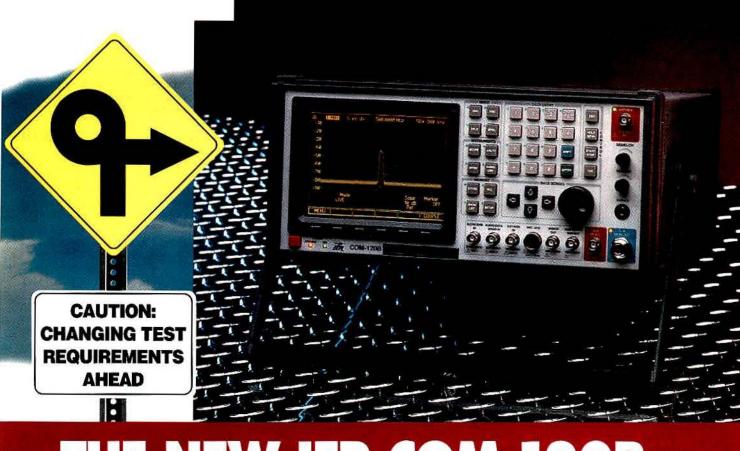
New products.

Circle 365

New products	
Circle 366	
SoftWright	Booth 762
Existing products Terrain Analysis Package (TAP): version 3 perform evaluation of existing or proposed coverage predictions, TV and FM broadcas wave, cellular, paging and two-way radio s version 1.1, Windows-based communication base for sites, towers, antennas, transmission receivers, combiners, splitters, grounding, but and fax directory, frequencies and equipments of the products.	I transmitter sites, radio sting, ITFS, PCS, micro- system design. SiteBase as site management data on lines, transmitters and backup power, telephone
Digital topography maps for more than 90 c	ountries, high-resolution
U.S. city limit files and U.S. ZIP codes. Circle 367	See classified ads
Sonic Communications	Booth 134
Existing products Headsets; ear microphones; throat micropracing accessories; wireless receivers; surdesigned products. New products	
Viper headset: single-ear, boom micropho Viper headset: single-ear, boom microphor Circle 368	
Spectrum Communications Existing products	Booth 1249
Paging transmitters; high-stability frequencast, RF link transmitters and receivers, amplifiers; power supplies; transmit and available: UHF, VHF, 900MHz, midband a Circle 369	repeaters, high-power receive modules. Bands
SRC Cables	Booth 1556
Existing products Coaxial cable assemblies; semi-rigid cable wave absorbers.	design software; micro-
New products LMR flexible coaxial cable assemblies; T replacement cables. Circle 370	Flex flexible semi-rigio
LMR flexible coaxial cable assemblies; Treplacement cables. Circle 370 STI-CO Industries	Flex flexible semi-rigio
replacement cables. Circle 370	Booth 730 ing custom fender-moun d to cellular/trunking se antennas in single and couplers, tuners and

Skylink wireless local loop system; ST-853 trunking controller.

Booth 991



THE NEW IFR COM-120B, AHEAD OF THE CURVE

Predicting tomorrow's technology is a difficult road to travel. But with the new generation COM-120B, you don't need road signs to predict the twists and turns of wireless communications testing. With its field proven performance and incorporating over a dozen new innovations, the COM-120B easily negotiates the course of wireless testing.

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test parameters and program files. This configurable data port turns the COM-120B into a remote controlled input/output source, allowing you to initiate tests by simply plugging into a modem. And with its unique internal/external file storage and retrieval system, the COM-120B offers you unrivaled data storage, test configuration and analysis power.

Of course, the new generation COM-120B is backed by the kind of service and support that you expect from a global leader in test instrumentation. For solutions that keep pace when communication technologies change, call 1-800-835-2352. Ask about our lease/rental and extended warranty programs, too.

"I found real solutions

at IFR Systems"



Summitek Instruments

Booth 136

Existing products

Line of passive intermodulation analyzers and accessories for testing antennas, cables, duplexers and integrated base stations.

New products

SI-1900A: PCS-band passive IM distortion analyzer; SI-850A: AMPS/GSM/ESMR passive IM distortion analyzer; SI-20A: low IM distortion load.

Circle 372

Swift Computers

Booth 888

New products_

SmartStor logging recorder for trunked radio. Circle 373 See ad page

Tad Radio of Canada Booths 1349 & 1448 Existing products.

Tad M8 mobile radio; Tad MD150 mobile radio; Relm communication products; Bendix/ King communication products.

New products

Tad M10 mobile radio.

See ad page 92

Talley Communications

Booth 425

Existing products

Distributor system integrator—provides engineering services to the mobile and wireless communications industries-warehouses in Los Angeles, Phoenix, San Diego and San Francisco.

Circle 375

TCC Industries

Booth 1136

Existing products_

Coaxial connectors: N, TNC, Mini-UHF, BNC, SMA, SMB, crimping tool, cellular accessories, instant hands-free, Cruisin Kit.

Liberty series: model TA2000E (instant hands-free), TA2000A (instant hands-free). Circle 376

Tecdia

Booth 559

Existing products

Single-layer parallel plate chip capacitors; GaAs FET protection mini boards and de power boards; wideband and high-current bias-tees; alumina substrates.

New products.

Dc power boards with TTL switch: models TFS20A58 and TFS20B58 control timing of the voltage on drain side of circuit and have an emergency shut-off for FET.

Circle 377

Tekk

Booth 419 Existing products _

Pro series hand-held radios; Pro series

headsets. New products_ PT-400 in-house paging systems (complete): numeric and alphanumeric paging systems; all new packaging; optional yellow cases for hand-held radios.

Circle 379

Telecommunications Group

Rooth 123

Existing products

Engineering services (structural, civil, analysis, consulting and fabrication); vertical real estate: space leasing and installation of monopoles, guyed and self-support towers; project management, specializing in turnkey installations.

New products

Teracom connectors; jumpers; ground kits. Circle 380

Teledesign Systems

Booth 1181

Existing products _

TSI9600 radio modem: 9600-baud UHF radio modem; TS2000 mobile radio modem: operates with any voice radio systems, including trunked repeaters.

New products_

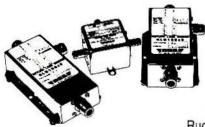
TS4000 high-speed radio modem: 19,200 baud modem integrated with a radio transceiver, including an embedded packet protocol for complete data transfer management. Circle 381

Telemobile

Booth 436

Existing products _

VSWR BRIDGES & TEST CABLES



FEATURES:

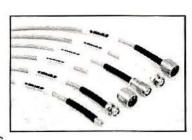
5 watt power High directivity RF reflected port Rugged construction

Using the EAGLE return loss bridge allows frequency domain reflectometry tests to be made easily and inexpensively. There is no need to spend thousands of dollars on a dedicated antenna tester. Simply use the EAGLE bridge with your present spectrum analyzer and tracking generator. This technique is described in our free application note. See offer below.

Price: \$469.00 for a 1.0 GHz bridge.

FEATURES:

Low loss Low Cost Custom labels Swept to 3.0 GHz Rugged! 60 lb. pull Excellent return loss



Are you frustrated with cable assemblies that break easily, are lossy at low microwave, or work intermittantly? Our bridge customers had the same problem. At EAGLE we now manufacture low-cost rugged test cables! Each one is tested on a vector network analyzer to 3.0 GHz. Our custom labeling makes cable ID a snap. Excellent return loss reduces disturbances to combiners and filters.

Price: \$29.00 1-4 quantity with "N" connectors.

Call for FREE application note: "Antenna and Feedline Measurements"

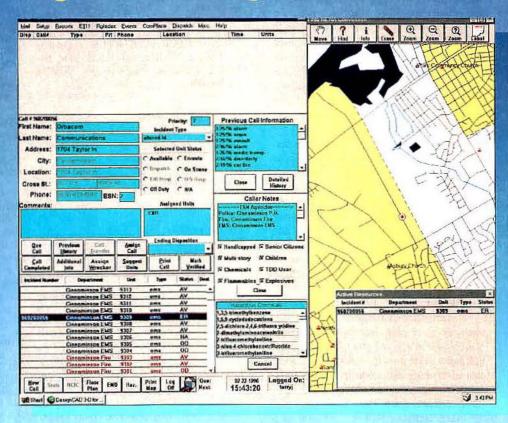


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Circle (66) on Fast Fact Card



PolyPhaser Corporation POLYPHASER CORPORATION HEADQUARTERS IS LOCATED IN THE CARSON VALLEY

estled in the Carson Valley and just minutes from Lake Tahoe, PolyPhaser Corporation and its 140 employees are headquartered in Minden, Nevada. The company is dedicated to providing lightning/electromagnetic pulse protection and grounding solutions for the communications industry. Founded in 1979 by Roger and Gayle Block, PolyPhaser designs and manufactures more than 2,500 models of coax, power and twisted pair protectors from within a 53,000 square foot state-of-the-art facility.

PolyPhaser custom designs products to meet customer needs in a variety of fields, including cellular, paging, broadcast, wireless. mobile communications, military, PCS, GPS, 9-1-1 sites, ham radio and power companies. Custom protectors are routinely designed, tested and produced, and often become part of PolyPhaser's future catalogs.

Among PolyPhaser's lightning protection products are coax entrance panels, cellular protectors, in-line power mains, global positioning system coaxial protectors, shunt-type power mains, rack panel protectors, educational material, LAN/data line protection, custom products, grounding components and power-supply protectors.

To further safeguard a client's communications equipment, PolyPhaser offers complete technical support, testing, training, consulting and a web site at http://www.polyphaser.com.

A current seminar PolyPhaser is offering consists of three eight-hour days. The first day addresses lightning and grounding fundamentals; day two discusses grounding theory, applications, methods and products; and day three delves into grounding case histories and offers hands-on learning activities.

When Lightning Strikes . . . Count on a PolyPhaser®. ■

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Wireless telecommunications systems; Phonelink point-to-point; Phonelink point-tomultipoint; analog and digital wireless systems for data, voice and fax.

New products

DTEL19 series digital three-channel (2+1) Phonelink operating at 19.2kbps (in VHF and UHF frequencies); DTEL64 series digital three-channel (2+1) Phonelink operating at 64kbps (in UHF and VHF frequencies); MTEL series multiline digital Phonelink 8-40 lines at 128kbps (in UHF and VHF frequencies); DRRT (digital rural radio telephone) digital point-to-multipoint low-capacity system, 1POTS plus ISDN remotes.

Circle 382

Telepoint

Booth 461

Existing products_ SR-20/SR-64 point-to-point and multipoint wireless radio-telephone link.

Circle 383 Telewaye

Booth 673

Existing products Conventional and auto-tuning combiners: duplexers; base station antennas; receiver distribution panels; wattmeters; site monitoring

equipment. New products.

Antenna power dividers 30MHz-2.2GHz with N or 7/16" DIN connectors; PCS yagi antennas 1.8GHz-2.0GHz, 9dB-12dB gain; 14channel high-power combiners for 350MHz and 760MHz.

See ad page 32F

Telex Communications

Booth 1412 Existing products.

Ear Mike; headsets; Magnacom emergency vehicle intercom; Magnarope.

New products

Telex Star Watch; Telex Jet Star I.

Circle 385

TESSCO

Booth 343

Existing products

Supplier to the cellular, paging and two-way industries offering more than 17,500 products from more than 260 manufacturers.

New products

TESSCO 1997 Buyers' Guide, a comprehensive source book, \$125 value free to qualified service organizations; TESSCO Magic, a buyers' guide and procurement software; available on CD ROM.

See ad pages 22-23

TGA Prism

Booth 279

New products

Prism Lite radio paging terminal; Prism III voice/fax processing platform: Prism TxBSC base station controller; Prism network firewall

Circle 387

Times Microwave Systems

Booth 339

Existing products_

LMR-300 low-loss coaxial cable; LMR-100A miniature coaxial cable; mini UHF connectors for LMR-400; midspan stripping tools, LMR-155 and LMR-600 Ultra Flex. Circle 388

Tower Systems

Booth 1186

Booth 262

Existing products_ Tower construction; site civil work; antenna and line installation and testing; complete turnkey installation and project management. Circle 389

Transamerican

Commercial Finance Existing products

Maintains strategic alliances with manufacturers in the wireless communications industry, providing customized inventory and accounts-receivable financing programs tailored to wireless communications dealers.

New products

Major account purchase program (MAP) gives land mobile dealers the ability to bid on purchase orders for large corporations, local, state and government contracts.

Circle 390

Transcrypt International

Booth 101

Existing products Stealth 25 portable digital radio; radio scramblers and signaling products; telephone scrambler and encryptors.

New products

VPEU II; MT50 rack for telephone security. Circle 391 See ad page 3

Transfector Systems

Booth 485

Booth 1127

Existing products CP-2365 ac voltage surge suppressor; TSJ-4BL transient suppressor for T-1 telephone

New products

Transtector APEX II-12φT.

Circle 392

Trident Micro Systems

Existing products

TNT trunking logic controllers; CR-355 call router; M-500 airtime logger; VM-400 voice

New products

mail.

PassPort NTS SMR networked trunking system; Metro Messenger mobile data terminal; Raider and Marauder UHF trunking logic controllers; Tuff Modem site modem.

See ad page 75

Trilogy Communications Existing products.

Booth 238

MC2 coaxial cable for transmission line: RMC2 radiating coaxial cable. Circle 394

Tru-Connector

Booth 139

Existing products_

7/16 series RF connectors and adapters; RF coaxial connectors.

New products

Tru-8010-SSX 7/16 male to N female panel mount adapter; Tru-8012-SSX 7/16 female to N female panel mount adapter.

Circle 395

Our PCS, NPCS & Cellular/GSM/Trunking Omnidirectional Antennas are built tough & conditioned to deliver unparalleled signal strength under the most rugged conditions

PCS/PCN omnis available with 6, 8 and 10 dBd gains

NPCS models available with 3, 6 and 9 dBd gains

Cellular/GSM and Trunking omnis are available with a variety of gain and downtilt options

For complete product information contact:

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Some products are not available in all areas.

Dealer Sales and Distribution

Trylon-TSF

Booth 369

Existing products.

Designs, manufactures and installs guyed, self-support towers and monopoles; manufactures fall protection systems for all towers.

New products______

Trylon fall protection systems for towers; Trylon monopoles.

Circle 396

See ad page 110

TWR Telecom

Booth 920

Existing products .

FAA-approved and ETL-certified aviation obstruction lighting.

New products

Dual red/white FAA-type L-864/L-865 obstruction beacon.

Circle 397

TX RX Systems

Booth 631

Existing products

Filters; duplexers; transmit and receive multicoupler systems; tower-mounted preamp; signal boosters; RF system products. New products______

423 series tower-mount preamp; 601 series channelized signal booster; 44 series transmit combiner.

Circle 398

See ad page 84

U.S. Sitelease

Booth 1184

Existing products

More than 100 sites for lease in Texas, Missouri, Kansas, Illinois and Minnesota.

Circle 399

VEGA, a Mark IV company

Booth 937

Existing products

Model C500 and C5000 series consoles; RP 200 series remote adapters; C-6024 touchscreen console.

New products_

Model TC560/RP250 trunking console.

Circle 400 See ad pag

Vertex Radio Communications Booth 1301

Existing products.

Full line of lowband, VHF, UHF mobiles, portables, repeaters, trunking systems; accessories.

Circle 401

See ad page IBC

Wacom Products

Booth 1353

Existing products.

Supplies coaxial cavity filters, duplexers, transmitter and receiver multicoupler systems operating in the 30MHz-960MHz band.

New products

Model WP-4953-3 cavity; model WP-4955-3. Circle 402 See ad page 92

WPCS

Booth 491

Existing products.

Cylink spread sprectrum; Rad data products; Racom 23GHz microwave; Unidial long distance; Nutel point-to-point; Zetron controllers; NACM credit checking; Primus distributor; Standard and Uniden radios.

New products

GTE Supply telecommunications products; Recoton accessories; GMS1 mobile data; and Multicel, a new WPBX system developed by WPCS

Circle 403

Wireless World

Booth 1161

Existing products_

WirelessWorld provides market updates, engineering information, applications articles and the latest news of the wireless communications industry's newly competitive technologies: broadband and narrowband PCS. Readers include PCS carriers, operators of other wireless systems, inter- and local-exchange carriers, dealers and resellers, and manufacturers and their reps and distributors. Circle 404

W&W Associates

Booth 1401

Existing products.

Replacement batteries; chargers; analyzers for two-way batteries.

New products_

New batteries for: ICOM CM-140, Kenwood TK260; Uniden 802, Eriesson KPC/Prism, Motorola GP350, Nextel; Alkaline packs for: Vertex/Yaesu VX500, Kenwood KNB12 and ICOM CM-140

Circle 405

See ad page 32A & 47

Zetron

Booth 921

Existing products

DTMF microphones; interconnect products, rural telephony; tone panels and repeater controllers; trunking remotes; trunking repeater controllers; paging encoders; paging terminals; paging accessories; software products; radio console systems; modular dispatch and PSAP accessories; telephone PSAP system; fire alerting system; message recorders;

alarm/status/control systems; wide-area voice/

data systems; RF monitoring.

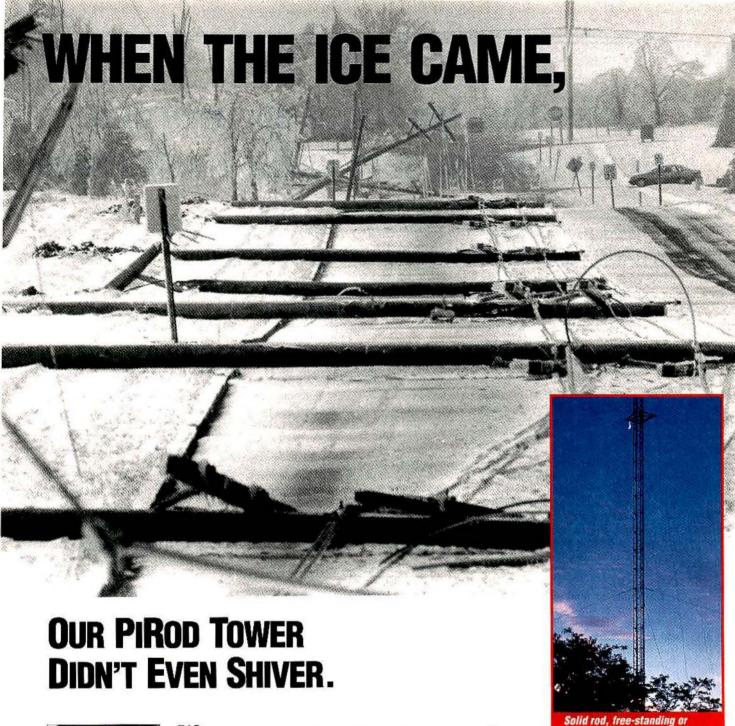
New products

Business and industrial: M284 tone remote; M220 PBX page finder; M37-max repeater pal; M48-jr repeater patch; M15T Flex pager tester; M15P custom encoder; paging and SMR applications: M498 expanded memory module; E-page software; M827 MPT 1327 trunking controller; RF site monitoring applications: M700 power status monitor, M702 monitor; M704 RF monitor; MZL 900 series power sensors; PCS antenna monitor; public safety applications: series 3000 key service unit; M970 1A2 caller ID system; M3100 PSAP telephone console; utilities and industrial applications: M1514 device page, alpha page alarming; M1515 VeriPage, paging system monitor; M1550 SentriMax for RF; ULTRAc for RF site monitoring; ULTRAc for RACS.

Circle 406

See ad pages 18 & 32E & 91







Dave Turner WMCC TV, Channel 23 Indianapolis, Indiana

"With more than two feet of ice at the antenna of our 1,000-foot PiRod tower, and guy wire ice eight inches in diameter, our tower bent like a banana. I recall my engineer saying that the tower wouldn't last five more minutes. But our solid rod PiRod tower stood there and straightened as the ice melted. No damage. No stress fractures. No problems. I guess that's when the quality of a solid rod PiRod tower comes through."

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Use the Internet to promote dealerships, servicing businesses

A modest investment of time and money provides national exposure to potential customers and reduces the amount of time required for customer service. Use the World Wide Web as part of a carefully considered marketing plan.

By Donald E. Koehler

The Internet is, unfortunately, subject to tremendous hype. It is touted as a cure for everything from poor corporate communications to keeping in touch with Grandma. Although it is not a miracle cure for a small business squeezed by competition, it is an exceptional opportunity for small (or large) business. Advanced communications, marketing, access to alternate sources for parts and components, and an enhanced business image are just some of the advantages of exposure on the "Net."

Connectivity

The ability to send and receive email across town, across the United States or around the world allows you to contact and sell to customers normally outside your reach. Consider it an adjunct to your regular marketing activities when budget time rolls around.

'We're open 24 hours a day'

The World Wide Web is the part of the Internet where commercial activity takes place. A global information warehouse, the Web is essentially a computer application continually running on the Internet.

An Internet service provider (ISP) can provide custom features for your business presence on the Web, allowing your marketing efforts to run 24 hours a day, seven days a week, and all for a relatively low cost. As with any other marketing tool, be sure you describe the desired outcome or set a goal for return: to increase sales by 5%, or to expand your brand name recognition out-of-state, for example. Another reason to set measurable business goals is

Koehler teaches at the University of Alaska, Anchorage. to avoid the pitfall of equating "hit count" with business success. Anyone accessing your Web site will generate a "hit" but not always a sale. (As in your store, there are "lookers," and there are "buyers.") Merely having a Web site does not ensure increased profit.

Combined marketing efforts

One radio-related, small business operator, with his common-sense approach to business, is a good example of Web marketing. Gary Nixon's small company, License Certification Service, Fair Oaks, CA, sells FCC-approved replica certifi-

As with any other marketing tool, describe the desired outcome or set a goal for return.

cates for licensees who desire a large, "frameable" version of their FCC General Radiotelephone Operator license or ham license. (By the way, Nixon checks your license information with the FCC before he sends the certificate.) Clearly, this is a niche market with a limited potential for sales. Nixon has included a low-cost Web site in his marketing plan. His three-fold method of communicating with customers includes:

☐ a Web site: www.quiknet.com/certs☐ an email address: certs@quiknet.com☐ a toll-free number: 800-792-3787.

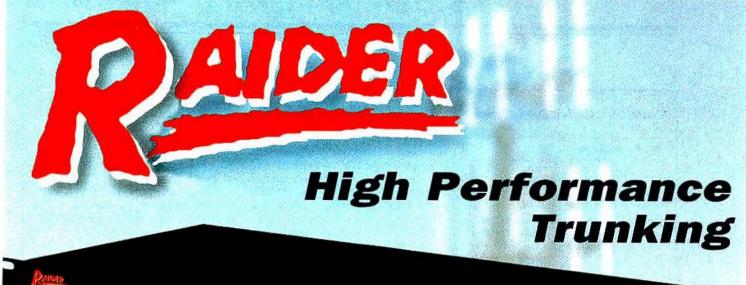
All of these communications resources are priced at attractive levels and have given Nixon solid performance. The disk space for Nixon's Web site costs him \$100 annually, and the ISP includes email delivery in that service charge.

Customers can download an order form from the site to return by mail, email the information or call toll-free. Because this marketing effort is largely automated, Nixon can run his business as an extra income-producer.

After "talking" with Nixon via email (and ordering the certificate—which looks good on the wall), I discovered that his site was a do-it-yourself project. It really is fairly simple. For example, I teach a crash course on Web site building at the University of Alaska, with students producing a usable product after only four hours of instruction. The Net itself abounds with information for do-it-yourself types. If you have better things to do with your time—and who doesn't—you can go to an expert and have a professional-looking Web site created for \$100 to \$300. [See the sidebar on page 76.]

In the budget plan, include the services of a "cyberbooster," who will ensure that your site is listed on all the bigger commercial Web directories and "search engines" such as Infoseek or Yahoo!. (Search engines direct Net users to the information they are seeking based on key words or subjects.) Customers cannot find your site if you do not promote it on your own. (Confer with the cyberbooster if referrals to your site from some directories generate less sales income than others. You may want to drop that directory if it generates more browsers than paying customers.)

As part of my daily work, I often "mine" the Net in search of goods and services related to my training projects. Even those companies that I contact because of mailings or brochures often have Net-connected email addresses available. This is an important factor in business





- LTR® Trunking Logic Controller
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- Repeater Disable Device for Co-channel Protection
- Easy interface and set-up with most repeaters
- Allows conventional and trunking users to share channels
- Interconnect Model Available



TRIDENT

Southwest dealer-servicer establishes Web presence to serve customers

By Susan Kern

Canyon State Communications, a land mobile radio dealer and Motorola warranty servicer with six facilities in Arizona and Texas, operates a comprehensive Web site for promoting its products and services. The Web site, with more than 40 pages of information, is located at www.canyonstate.com.

Chuck Potter, Canyon State's vice president and chief operating officer, said the decision to build an Internet web site addressed management's desire to reduce

Kern is president of SK Communications, Phoenix.

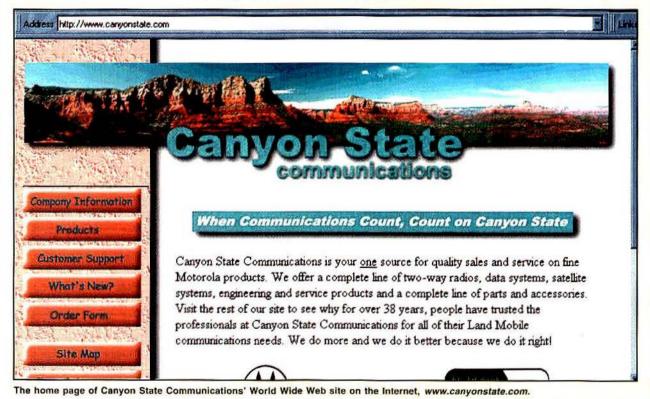
operating costs and to improve marketing and customer service. "For high-tech companies, especially land mobile radio businesses, a presence on the Internet demonstrates an ability to make the most of the latest technologies," Potter said. "We believe a Web presence will help us work more efficiently and keep our customers better informed."

Canyon State commissioned Bobby G. Thompson & Associates, Phoenix, to build the Web site. Thompson, the firm's president, served for 33 years with Motorola's national service organization prior to starting his own two-way radio and wireless communications consulting firm in 1996. Potter said Thompson's expertise and understanding of the land mobile business, com-

bined with his Internet knowledge, helped Canyon State strategically map out the various pages and components of their web site.

A corporate profile of Canyon State Communications and a detailed listing of products and services are included in its web site. Visitors to the site can make transactions online and receive answers to frequently asked questions (FAQs). A "What's New" section also contains up-to-date announcements and offers links to other relevant Web sites.

Thompson & Associates works with both small and large land mobile radio businesses to establish Web sites. Pricing starts at \$100 for setup and \$20 per month in server rental fees.



decisions. "Can I contact these vendors 'after hours?" Alaska is four time zones west of the East Coast, which makes it hard to reach vendors for a fast turnaround on a quote. Sources for parts, and that "odd" piece of equipment, often can be found quickly on the Net, rather than using the old-fashioned mail-catalog-mail routine.

Post a Frequently Asked Questions (FAQ, pronounced "fack") list that discusses your products or services. Manual

or technical bulletins can be made readily available on the Net, which can save your expensive manpower from answering common questions time-and-time-again. A simple, text-based document will be readily accepted by most Net users. Conversion of existing product documentation (document files) to hypertext markup language (HTML) or Adobe Acrobat (PDF) formats (the communications protocols of the Web) is easily done. Inclusion of pho-

tos or line drawings, such as blueprints or a parts diagram, will add increased value to your Web presence, with minimal cost. Remember, content is king on the Web!

Connect the dots

There is cachet in being a modern, connected business that comes with a Web presence. Buying a domain name is a quick and effective way to establish your company as a player on the Web.



When <u>not</u> to hear about the "good deal" Purchasing made on the antennas.

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PERFORMANCE

Fact is, you simply cun't buy an antenna that performs better than a Larsen! Each design is developed to the highest electrical standard, then fully tested in our own RF laboratories. If any antenna design cannot meet our standards, it just won't be sold.

PRODUCTS

We are small antenna experts! With over 1000 different antenna designs from 27 MHz to 2+ GHz, we have the right one for your application. Our design team can produce any specialty portable, mobile and base antenna to your exact specification.

INNOVATION

For over 30 years, Larsen has been on the cutting edge of antenna development. We are the ones who first developed many of the innovations now considered "standard quality practice" by the competition.

SERVICE

Our dedication to customer service is well known in the industry. Frankly, we believe it is our job to move mountains to support our customer. We will, just ask!

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These Web sites contain more information on shareware or freeware HTML editors and search engines:

www.cyberspace.com/~cerelli /htmledit.htm

www.cobWeb.washcoll.edu /htmleds.htm

These editors work with a normal word processing program, such as Microsoft Word for Windows. Don't worry Macintosh fans, these types of add-on programs are also available for the Macintosh-, Liunix-, and Unix-based operating systems. Line drawings, photos or other images can be scanned to convert them into a ".gif" format to provide detail with minimum file size. Enjoy.

-Donald E. Koehler

Gaining ownership of a domain name is cheap, usually less than \$200, and it can be handled through your cyberbooster. Domain names are the part of a Web address (technically referred to as a uniform resource locator, or URL) that lies between the name of the computer server ("www.") and the type of organization (".com" for commercial, ".gov" for government, etc.); for example:

www.yourcompanyname.com.

If you don't think this will put you up with the "big boys," take a good hard look at some television commercials. If Toyota, ABC, CBS and Motorola think a domain name is an important marketing tool, maybe you should consider it.

A final caveat

The way people access the Web may change in the near future. Unlimited Internet access for a small monthly fee is likely to become a connection-time-andbandwidth-based fee structure. The information superhighway may change into a combination of toll road and pay-perview. The traffic strain on telco facilities already is being felt in California. New York and even Alaska. A presence on the Web requires you to pay some attention to macro trends and to have a good idea of what you want the Web to do for your company. For now though, a little thought and a relatively small investment can provide a demonstrable return to your company's bottom line.

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before./Kaval's single channel OnFrequency Radio (OFRIM) repeaters
and wide band amplifier technology
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where it's needed most./Kaval's family of products and patented technology are easily integrated into VHF. UHF. 800 and 900 MHz systems for two-way radio, paging, cellular, PCS and data communications./
And you won't find a more costeffective solution anywhere else on the planet./Call 1-888-86-KAVAL and let Kaval develop a system solution for your coverage needs.



Circle (75) on Fast Fact Card

Antenna technique boosts capacity and coverage, reduces interference

Electronically controlled, directive antennas help cellular site operators to reduce interference, increase capacity, improve coverage (both in-building and rural) and optimize hand-offs.

By Sheldon Meredith, M.S.E.E., and Andrew Crowley, M. Eng.

Cellular operators and system planners constantly strive to improve their networks. Once basic RF coverage has been achieved and the time comes to add capacity, interference control becomes the biggest concern. Traditional solutions to the capacity vs. interference dilemma are frequency planning (including sectorization), antenna pattern manipulation and the addition of cell sites. Base site vendors also strive to improve network

Meredith is chief engineer of the Applied Research Group, and Crowley is Smart System product manager, at Celwave, Phoenix. The company manufactures the Smart System electronically controlled, directive antenna described in this article.

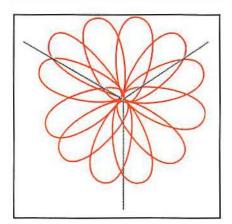


Figure 1. A typical Smart antenna cell site. An omnidirectional or sectorized cell site typically is replaced with three multibeam panel antennas. This divides the cell site into 12 30° beams, providing a substantial increase in carrier-to-interference ratio (C/I) performance and coverage.

performance by enhancing call-processing algorithms. Unfortunately, most of the opportunities for large improvements were exploited years ago, and newer improvements tend to be incremental because the cellular site infrastructures are tenacious.

Conventional optimization

System designers are generally famil-

iar with the theoretical flat-earth model for RF propagation and frequency planning. The N = 7 frequency reuse version of this "perfect" model targets 17dB of carrier-to-interference ratio (C/I) for acceptable call quality. Still, the model does not account for:

- · terrain height deviations
- · azimuthally dependent path losses

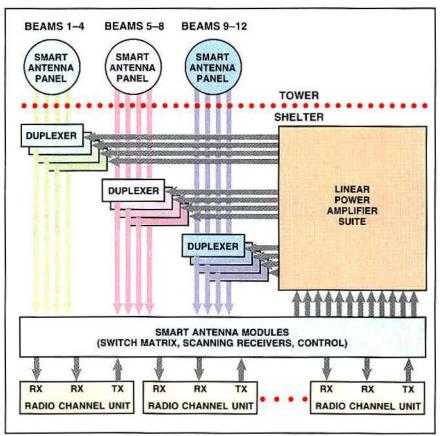


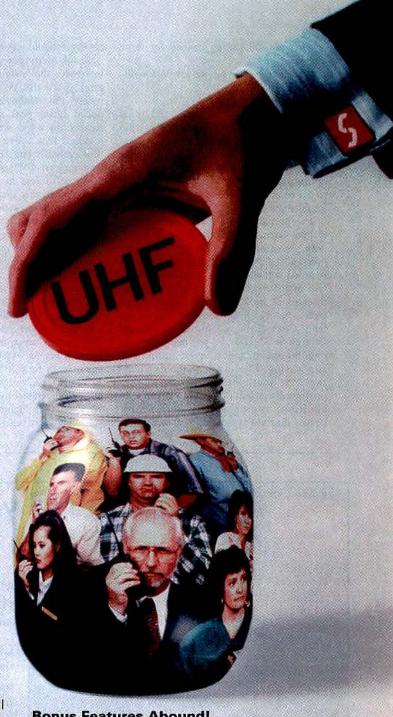
Figure 2. This block diagram of the Smart system shows the key components of the directive antenna.

Jammed-Up Repeater Networks

Now convert your crowded UHF community repeaters into a subscriber-efficient trunking system. Thanks to SmarTrunk Systems, Inc., you can handle the changeover WITHOUT INTERRUPTING NORMAL SERVICE. SmarTrunk II is a fully compliant, digitally-based trunking system that can be installed in parallel with your current system while upgrade occurs. Most important, SmarTrunk II has a proven track record in thousands of systems worldwide. In fact, such key players as Motorola, Kenwood, Yaesu and Alinco have adopted SmarTrunk II as a low cost UHF trunking solution.

The heart of the system, the SmarTrunk II Controller, offers such features as programmable call limit timers on a per user basis, radio kill for non-paying users, and the storage of complete call record accounting information. Custom trunking logic boards are available for a wide range of mobile and portable radios.





Bonus Features Abound!

- Supports individual calls, group calls and telephone interconnect
- Up to 4,000 group or individual I.D.s per system
- Proprietary digital signalling eliminates non-paying radios
- System privacy—other system users cannot eavesdrop
- Capable of operating in environments with co-channel users
- Supports gradual conversion from conventional to trunked operation

Circle (76) on Fast Fact Card There's Lots More, Call or Write:

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- · log-normal fading caused by large
- · variable power output levels for different mobile units
 - · hand-off hysteresis

Inserting these factors in the ideal propagation model quickly shows that deterministic impairment conditions are common, and that they affect quality. These factors force system designers and optimizers to use all available techniques to recover from these serious quality impairments.

The primary tool for interference control has been sectorization. Unfortunately, with sectorization, quality improvements come at the expense of capacity. A threesectored cell site suffers a capacity reduction of about 30%, compared to an omnidirectional site. To regain capacity lost from sectorization, additional sites are built. Considering an initial investment as high as \$1,100,000 per cell site (plus ongoing maintenance, spare equipment, site leasing, T1 and telephone line leasing), the multiyear cost of new sites profoundly affects operating profits. In addition, zoning and litigation processes that always make new site availability tenuous cannot be ignored.

Trunk-hunting sequences are used to interleave the assignments of radios that might normally be interferers. Unfortunately, this method's effectiveness is reduced during peak usage hours. Antenna downtilting works with sites that are a few hundred feet above average terrain, but this method's benefits are limited for the vast majority of sites (which are about 100 feet or less in height). Other tools, such as dynamic channel lockout and inner-outer tiers, provide further flexibility, but still are technical bandages, used in an attempt to cure the symptoms rather than the disease.

New approach

Instead of trying to "patch-up" existing cellular base sites with minor fixes, we decided to change the nature of the problem with a smart antenna system. A site is modified to accommodate many discrete antenna beams (typically three panel antennas with four 30° beams for a total of 12 beams), each of which can be accessed by any site radio by means of electronic switches. (See Figure 1 on page 80.)

In the smart antenna system, RF sig-

nals from cellular phones are detected on the 30° antenna beams by dedicated scanning receivers. The beam selections are made by dedicated microcontrollers via electronic switches at rates high enough to effectively track multipath signals in severely cluttered environments. The best two receive beams per signal are then connected by the antenna's switch matrix to the radio's diversity inputs. The transmit signal from each radio is routed by the switch matrix to the best beam for transmission.

The advantage of narrow beams is that the downlink power is concentrated in the mobile's direction, and uplink signals are angularly discriminated from interference. (See Figure 2 on page 80.)

Our system uses 12 narrow antenna beams, either to retrofit a towertop or rooftop application or to create a truly distributed microcellular configuration. The narrow azimuthal beamwidths provide increased antenna gains (compared to typical panels). This increased gain allows absolute power to be reduced on the downlink while improving signal reception on the uplink. The increased gain can manifest itself by coverage extension for



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Mini Coax Support Blocks



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Universal Angle Adaptors



Entry Port Systems



Stand-off Adaptors

rural sites or by improved in-building coverage in urban settings. To solve different operators' problems, seven multibeam antennas are manufactured with 13dBd to 19dBd gain for both vertical and dual polarization.

Omni implementation

Cellular operators and system planners have a proven method for dealing with

C/I problems that occur when many channels are added to omnidirectional sites: sectorization. Sectorization comes with a high price, though. For an average C/I improvement of 6.5dB, a cell site converted from omnidirectional to three-sector will exhibit a 30% to 40% capacity decrease.

The cost-effective, technically sound alternative to sectorization is the omnidirectional trunking smart antenna system. For about the same price as sectorization, a site can be converted to a smart system with significant improvements over a sectored site.

The omnidirectionally configured smart system has the following advantages over a three-sectored site:

- · no trunking losses.
- 5dB to 13dB C/I improvement over three sectors (Users have measured C/I improvements of 20dB compared to omnidirectional sites.)
- · improved sensitivity and coverage due to additional antenna gain.
- · reduced downlink interference with other sites due to the narrow beams,

On a typical site, these advantages result in a decrease in the number of dropped calls and a corresponding improvement in marginal calls. In addition to these advantages, the smart antenna system does not have cavity combiners. thereby removing the constraints of 21channel spacing imposed on frequency planners. Other benefits of removing cavity combiners include remote tuning of radios and, possibly, dynamic channel allocation.

Sectorized implementation

Dramatic improvements in capacitybetween 30% and 40%-can be achieved by converting sectorized sites into smart antenna omnidirectional sites. Yet operators and system engineers have worked hard to optimize sites using sectorization. frequency planning, antenna downtilting, channel interleaving and channel lockout to achieve the present performance. They are reluctant to risk all these iterative gains on a new technology.

Fortunately, the smart antenna system still has considerable advantages in a network when configured for sectorized implementation. Extensive field trials with sectorized smart systems carrying commercial traffic resulted in a reduction in dropped calls ranging from 50% to 70%. The combination of reduced interference and additional gain of the smart antenna can provide as much as 13dB improvement on all calls. Anyone who has experienced a call with C/I at 17dB vs. 12dB knows that the implications for the subscriber are dramatic. The voice-quality data gathered during our trials confirm these improvements. In some marginal areas, the voice was unintelligible on the standard sectorized system. Simultaneously, on the smart antenna system, the call had high audio quality.

Multiple field trials show that the improvement in C/I and improved sensitivity allow a frequency reuse of NK = 4 with a sectorized smart antenna system.



- 7/16 DIN Connectors, optional N-type connectors available
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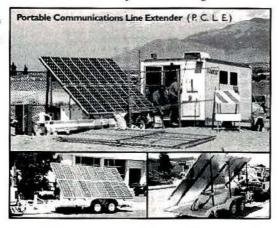
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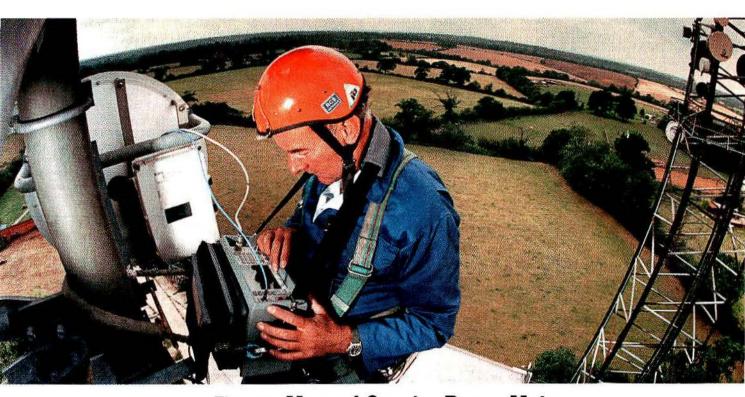




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The tighter frequency reuse means that network capacity can be increased about 90%. Alternatively, large sections of the cellular bandwidth can be dedicated to digital systems, and smart antenna improvements can be used to maintain the quality and capacity of the advanced mobile phone system (AMPS) or narrowband AMPS (NAMPS) system.

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Our smart antenna system is an appliqué and does not require digital interfaces with the site controllers, the switching office or the voice channel controllers. It has a straightforward RF interface to the base site radios.

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The retro-targeting version provides capacity increases, bidirectional interfer-



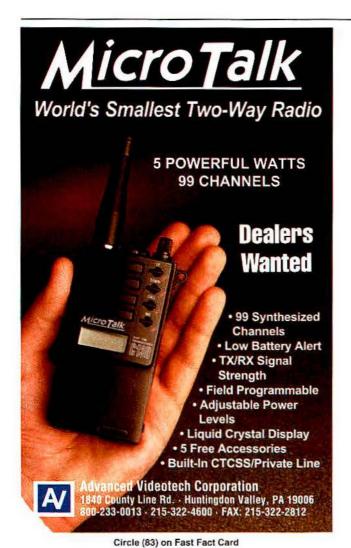
A field trial used Celwave's largest antennas for extended range and improved sensitivity. These 19dBd multibeam antennas were mounted directly to the tower.

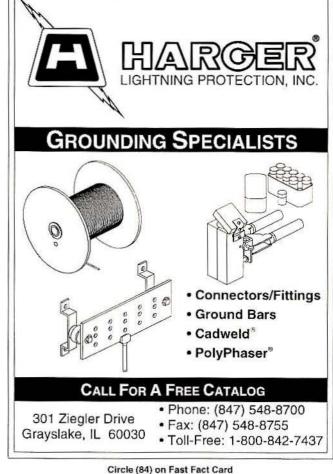
ence improvement, coverage enhancement and reduced absolute output power (for a fixed effective radiated power [ERP]). The fixed, multibeam antenna system (uplink or retro-targeting) provides hand-off characteristic optimization, another benefit of significance to site operators. Because the system can have 15° or 30° antenna beamwidths and each of the antenna beams has its own lownoise amplifier (LNA), the LNA gain can be adjusted to optimize hand-offs in any direction. In existing systems with 120°

sectors, a single hand-off threshold applies to every sector. This causes serious problems, because the optimum hand-off level for a mobile on an elevated freeway in one direction might be 10dB or 15dB higher than for a mobile unit in a dense cluster of buildings in a different direction. One of three conditions results: either the mobile on the freeway drags a call into the adjacent cellular site, the mobile in the building cluster is constantly requesting hand-offs, or both of them hand off in a non-optimal manner. With this system, both mobile units' signals can be compensated to optimize hand-offs and to greatly reduce hand-off

The multibeam antennas used with this system are passive. The system design avoids towertop active elements to enhance reliability and maintainability.

The system uses a new linear power amplifier (LPA) configuration (called a spatial transform amplifier) that "load-shares" all of the transmit linear power amplifiers. With this scheme, an individual amplifier failure has minimal effect on site performance and will not cause service to be lost on any base site radios. The





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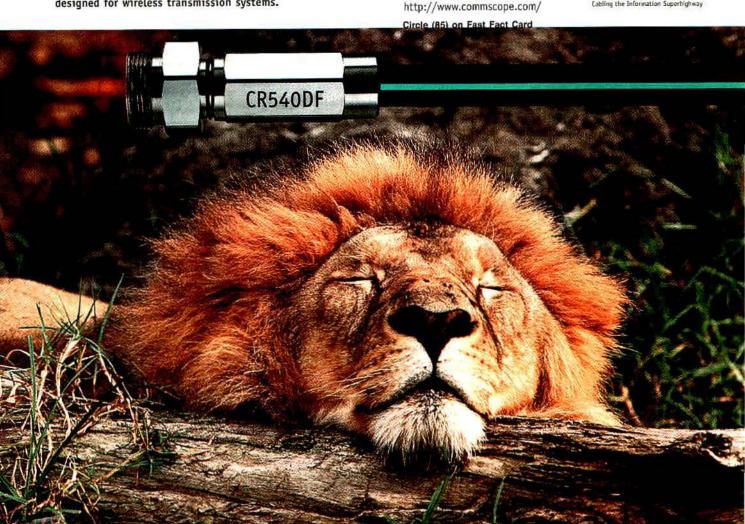
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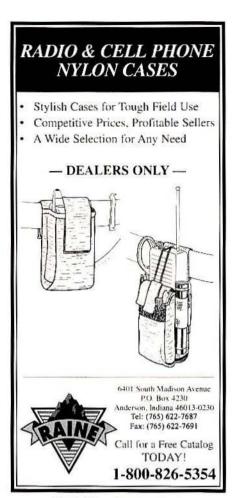
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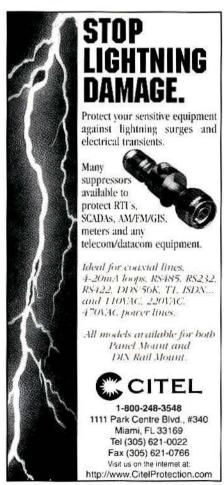
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The pre-production Smart system (dark cabinets) is installed next to the radio racks.

amplifier can then be repaired when technicians are on routine duty rather than on an emergency call.

Integration with future technologies

Operators intending to use timedivision, multiple-access (TDMA) modulation, Global System for Mobile Communications (GSM) or code-division, multiple-access (CDMA) technologies will be able to continue to use that hardware in parallel with the analog smart products until smart systems for those technologies are commercially practical. We are working with multiple original equipment manufacturers (OEMs) on methods of sharing antenna systems and linear power amplifiers between our product and other systems. Our system does not impede the installation of these other technologies in the near term. In fact, it actually provides capacity increases that may free spectrum for these technologies.

Additional functions

▶ Remote node option — The system is a true microcell controller. It does not differentiate between multiple beam inputs and multiple microcell inputs. This remote node option allows antennas to be placed inside convention centers, in parking garages and in "coverage holes." Antennas can be connected to the base site via fiber-optic, microwave or millimeterwave links without radios dedicated to the remote locations. The common pool of radios at the base site is available to the remote node as if it were another antenna beam.

▶ Remote diagnostics — The system allows the operator to remotely monitor and record beam selections and signal strengths for each radio at the cell site in real time. This remote interface also can be used for monitoring internal and external power supply voltages, transmit amplifier status and site alarms, and for reprogramming the antenna system. The smart system's supervisory controller is designed to integrate easily with network operations centers, providing alarm messaging and complete remote control.

▶ Redundant operation — The system includes no single component that, were it to fail, could force a cell site off-line. Distributed control, load-sharing power supplies, distributed frequency references, load-sharing LPAs and load-sharing LNAs make the system extremely reliable. Line-replaceable units (LRU) are used in addition to subsystem components, so in the event of a failure, they can be replaced in a matter of minutes. New LRUs are automatically recognized and programmed without additional steps required by the operators.

► Visually unobtrusive antennas — The system uses one multibeam antenna per face. On an existing tower or building top, these panels can be mounted on the towers themselves and do not have to be mounted on the traditional "top hat." The antennas are slightly larger than standard panels, but because only one is used instead of three or four, zoning and landlord issues are minimized. When sites are converted to the smart system, the "top hat" can be removed from the towers and replaced with three panel antennas mounted directly on a monopole. For new sites, use of smart antennas without the unsightly top hat may be necessary to gain zoning approval.

Conclusion

The smart antenna system is a breakthrough tool for network planners and operators. It provides the first real alternative to sectorizing and can be used to achieve network capacity increases as high as 90%. The system can be run in parallel with new technologies and eventually will be integrated with those technologies.

The system dramatically increases analog network capacity, interference control, in-building coverage, hand-off optimization, site reliability, rural coverage and microcellular architectures.

These improvements can reduce the number of new sites that have to be built, can improve performance and can have a direct influence on the profits of network operators.

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TDOA technology for locating narrowband cellular signals

Cellphone location involves several practical and technical considerations. Time difference of arrival (TDOA) technology provides accuracy for locating analog cellphones in urban environments.

By Louis A. Stilp

Immediately after the first mobile user headed off into the sunset with a cellphone, someone else wondered where he went. Thus, the idea for locating cellphones was born.

Many location techniques have been tried with varying degrees of success. Based on our work with operational cellular systems, time difference of arrival (TDOA) has proven to yield the best results in urban, suburban, and rural areas for analog advanced mobile phone service (AMPS) cellphones. The following information examines the issues involved in locating cellphones, and supporting evidence for TDOA as the technology of choice for analog telephones is described. The same arguments can be extended for digital cellular and PCS systems, although these systems have not been field-proven yet.

Positioning options

Many technologies for locating cellphones are based on modifications to the cellphone itself. Global Positioning System (GPS) technology is the most commonly discussed option. For locating unmodified cellphones, three basic alternatives are available: measuring signal attenuation (Doppler shift), angle of arrival (also called direction of arrival, or DOA), and TDOA. We have focused on TDOA because of its high degree of accuracy and affinity for use in cellular systems.

Time difference of arrival

GPS is a TDOA-based system, as are most of the systems proposed for the

Stilp is vice president of The Associated Group, Bala Cynwyd, PA. The Associated Group developed and markets TruePosition cellular location technology based on TDOA. Location and Monitoring Service (LMS) band recently allocated by the FCC. TDOA systems use location receivers at multiple sites dispersed over a wide area; each of the sites has an accurate timing source. A signal transmitted from a mobile device propagates at 1,000 feet per microsecond to all of the antenna sites, where the signal reception is time-stamped. The differences in time stamps are combined to produce intersecting hyperbolic lines from which the location is estimated.

TDOA systems are subject to many of the same urban multipath problems as angle of arrival systems. Multipath distorts the shape of the signal and the group delay, making it difficult to accurately determine the point in the signal to be measured by all receivers.

For this reason, most TDOA systems historically have been wideband (>1MHz). TDOA technology for narrowband signals was first examined by Turin with acceptable results for many applications. We have been able to both duplicate and enhance the results for AMPS cellphones.

Choosing the channel

To maximize the potential for successful location, we chose the reverse control channel for our TDOA system. Some of the reasons are as follows:

☐ Although both channels are always modulated during transmission, the reverse control channel's modulation characteristics are significantly better. The reverse control channel's sidelobe peak (i.e., bandwidth) is ±10kHz vs. the ±6 kHz for the supervisory audio tone (SAT) on the voice channel. The frequency deviation (i.e., amplitude) is ±8kHz for the control channel versus ±2kHz for the voice channel.

☐ The control channel is always transmitted at constant power and at the system maximum (typically 600mW), while the voice channel is power-controlled

during the transmission over a 27dB range (6mW to 3W). TDOA algorithms depend on adequate signal-to-noise ratio (SNR) at all receiving sites. Although the power modulation does not significantly affect the SNR at the cell site communicating with the cellphone, other location receiving sites can be negatively affected by the wide range in transmitting power.

□ Because the reverse control channel is bursty by nature, collisions and cochannel interference statistically occur less frequently than on the reverse voice channels.

☐ The voice channel has no identifying information associated with it; therefore, a TDOA system must request the cellular phone/voice channel mapping for the specific instant in time that the system will attempt to locate the phone. The control channel, by contrast, always has the identifying information contained in the transmission.

☐ Cellphones transmit on the reverse control channel when not engaged in a voice conversation. Many applications for which a TDOA system would be deployed should not have to depend on a user placing a call.

The reverse control channel does have one drawback: it cannot be used to locate a cellphone that is engaged in a conversation. The cellular air interface standard is structured so the call setup messages use the control channel, but handoff messages are sent in-band on the voice channel to conserve resources. Most end-user applications can be easily supported with a so-called "point of origination" location system, but in a few cases tracking during the length of a call would be valuable; therefore, we included use of the reverse voice channel as a secondary means of location.

Cramer-Rao bound

Although the AMPS reverse control

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channel is narrowband (<30kHz), TDOA systems can still locate cellphones with an accuracy of several hundred feet. The Cramer-Rao bound defines the theoretical lower limit of signal measurement accuracy as determined solely by the characteristics of the signal. This bound does not factor in the real, physical effects of actual antennas, analog components and environmental anomalies. The Cramer-Rao bound of any transmission is defined solely in terms of a signal's bandwidth, transmission time and

received SNR at the two antennas of a TDOA baseline. (A baseline is a pair of geographically separate antennas used for the time difference calculation.)

System hardware and accuracy

When we began examining existing cellular base station equipment TDOA suitability, we discovered that most equipment was not suited, nor intended, for high-accuracy time measurement. This was not surprising because the de-

modulation of voice channels for communications purposes requires timing stability only on the order of microseconds. Therefore, new equipment designs were required for TDOA systems. We have developed several generations of test systems, increasing stability and accuracy. Following are the important areas of system hardware that affect accuracy:

☐ The timing reference used at each of the receiving times must have a low drift rate and low phase noise. Drift rate affects how often the system requires calibration, and phase noise affects the system's ability to discern multipath effects from other systemic errors. For a baseline connecting any two receiving sites, using a rubidium oscillator as a timing reference was found to contribute less than 20ns of timing error, root-mean-square (RMS).

□ Each receiving site in a TDOA system requires a variety of intermediate frequencies for internal mixing and sampling. These frequencies must be derived from the timing reference to avoid introducing additional timing errors. The phase-locked loops used for generating these local oscillators must minimize the phase noise created within the loop. Phase noise introduced within the loop will later affect the cross-correlation processes used for TDOA and the ability of the system to identify components of multipath.

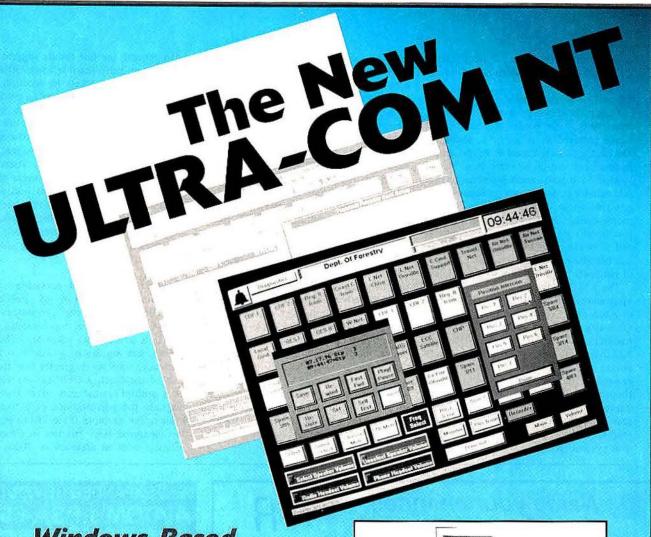
The reverse control channel band spans 630kHz for a typical 21-channel AMPS system. Most receivers will have several stages of filtering prior to sampling. Depending on the filter response characteristics chosen, a filter can have a significant delay variation across the band, which may vary with time, temperature and other factors. To reduce the filter contribution to TDOA error to 10ns-30ns, the filter requires periodic calibration by both external and internal signal sources.

☐ The choice of receiver technology also affects the TDOA system contribution to error. TDOA relies on cross-correlation of baselines, in which each receiver at the end of the baseline independently receives the transmitted signal. Wideband digital receivers (>1MHz) offer better performance and matching, both within a single receiver system where diversity antennas are used and between receiver systems at different sites. The wideband digital receiver contribution to error was found to be less than 20ns RMS, not counting quantization errors.

Our testing with TDOA systems has yielded increasingly better performance with each generation. The current system hardware generation is expected to affect accuracy on any baseline by no more than 50ns, RMS. This places the system







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contribution to error on par with that of the signal (i.e., Cramer-Rao bound) itself.

The effect of multipath

Multipath, also known as delay spread, refers to multiple copies of a transmitted signal received at an antenna. Multipath has been generally found to be the single largest contribution to error in a TDOA system. Multipath causes problems in normal cellular system operation because it is possible for a direct path signal to be momentarily canceled out by a reflected (multipath) signal; diversity antennas at cell sites alleviate this cancellation problem because of the statistical independence of multipath even within a single cell site.

The RMS delay spread in an urban environment will vary with the "signature" of each city (Turin and Lee), but it is generally about 1µs to 5µs, which would translate into an error of 1,000 feet to 5,000 feet if only the multipath at a single cell site were considered. Past considerations of TDOA systems have focused too much on this single delay number. This fails to take into account that multiple receiving sites are used to receive the transmitted signal in a location system, while only a single site is

used in a cellular system.

The amount of multipath experienced by an antenna can be greatly influenced by the type of antenna (omnidirectional or sectorized), the horizontal and vertical beamwidth of the antenna, and the amount of downtilt. If the antenna has more gain in the direction of the cellphone (i.e., the direct path signal) and less gain in the direction of multipath, then the SNR is effectively boosted. The type of sectorized antennas used at most cell sites (80° to 90° beamwidth horizontal, 10° to 15° vertical) meet this criteria.

In addition to sectorized antennas, there are "smart" antennas that use multiple antenna elements (eight or more) per sector; these antennas use electronic beamsteering to maximize the gain in the direction of the strongest signal and minimize gain elsewhere. [See "Antenna technique boosts capacity and coverage, reduces interference," p. 80.] If these antennas are installed primarily for voice quality purposes, and if the antennas' electronic beam-steering can respond quickly enough during the transmission time of a reverse control channel (100ms), then our TDOA systems certainly can take advantage of these antennas.

In general, our test results suggest it is not economically feasible to install these types of antennas solely for location purposes. While the antennas are an enhancement vs. sectorized antennas for wideangle multipath, the antennas do not provide much assistance for narrow-angle (<15° between the reflected signal and the direct signal) multipath. Statistical analysis shows that narrow-angle multipath makes up a significant portion of multipath. This is because more reflectors are located nearer to the cellphone's transmitting antenna (at street level) than are located near to the receiving antenna atop a cell site.

Geometric dilution of precision

Geometric dilution of precision (GDOP) refers to the geometry of a TDOA system's receiving antennas relative to a transmitting telephone. The geometry can significantly affect location accuracy, equal to or greater than the effect of multipath. GDOP can be viewed as a multiplier that can either boost or degrade the performance of a location system. For example, if the TDOA process has measured every baseline in a location estimate with an accuracy of 200ns (200



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feet), but the geometry of the antennas resulted in a relative GDOP of 3.0, then the final location estimate could have an error of as much as 600ns (or 600 feet).

Modeling shows that the receiving antennas used for a location estimate should be evenly distributed in a circle around the cellphone. Practically, this is not always the case, but a good TDOA design should reflect the best geometric orientation to increase the odds that every location estimate has good GDOP. This has required the development of new modeling software that parallels the propagation models first created for cellular systems.

Other effects of system design

A TDOA system must be designed for locational accuracy using techniques similar to those used for implementing a cellular network for voice. However, the techniques are not identical, primarily because a cellular network is designed using the forward channel as the driving criteria, while a TDOA system uses the reverse channel as the driving criteria. In general, the design coverage should attempt to yield a 20dB-25dB SNR (before

integration and processing gain) at more than three receiving sites for any cellular reverse control channel transmission from any point in the covered area.

Some of the design factors that influence the location accuracy of a TDOA system are:

- unumber of receiving locations.
- unumber of diversity antennas at each site.
- average distance from the transmitting cellphone to each of the receiving sites
- average height of the receiving antennas.
- ☐ average antenna power gain in the direction of the transmitting cellphone.

Results from testing TDOA systems

Using narrowband systems from the early 1970s, Turin reported location error results from urban environments of about 870 feet RMS. Using TDOA systems with analog receivers and GPS as the timing reference in a semi-urban and suburban environment, we have reported results of 355 feet RMS. Using TDOA systems with analog receivers and rubidium oscillators as a timing reference in a dense urban

environment (high-rise, mid-rise, and low-rise buildings) with significant multipath, we reported results of 200 feet RMS. These tests with analog receivers were to verify the performance of previous TDOA systems before proceeding with more costly and more advanced wideband development.

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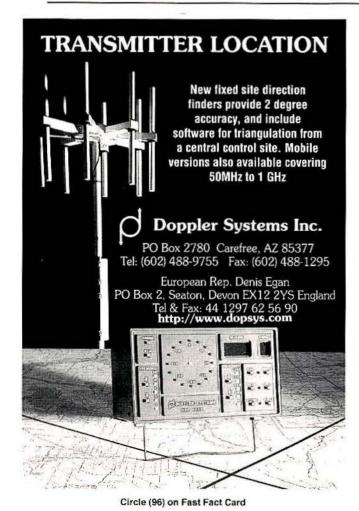
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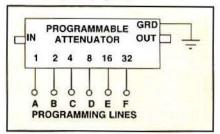


Figure 2. A programmable attenuator can be used with the programming lines extended to a remote location. In a vehicle this would allow the driver to adjust the attenuator from the driver's position while the actual attenuator might be placed at the input to the receiver.

measurement at one location.

Telephone line margin

Attenuators can be used in a similar manner to check the safety margin on a remote-control line provided by the telco. Excessive line loss can cause problems such as intermittent keying of the transmitter (or other intermittent control functions) and low transmit-receive audio. Audio attenuators can be constructed with various amounts of attenuation for such testing. Balanced pads should be used on balanced telco lines. A balanced "H" pad is shown in Figure 5 at the right. The "H" pad consists of four-arm resistors (RA) and one-leg resistor (RL). The four-arm resistors are of equal value for a simple attenuator pad where the input and output impedance are equal.

Table I below shows the value of arm and leg resistors for various amounts of attenuation for a typical 600Ω line. Look for a safety margin of about 6dB. To check, insert a 10dB attenuator pad and have the console operator at the other end of the line key the transmitter. If the transmitter keys reliably, then you have

Table 1. Arm and leg resistor values for attenuations of 1dB-20dB on a 600Ω line.

RA	RL
(Ω)	(Ω)
17.3	5200 2582 1703 1258
34.4	
51.3 67.9	
99.7	803
114.7	669.6
129.2	567.7
142.9	487.1
155.8	421.6
245.4	121.2
	(Ω) 17.3 34.4 51.3 67.9 84.0 99.7 114.7 129.2 142.9 155.8

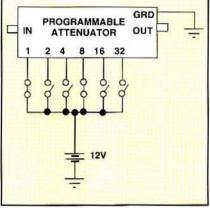


Figure 3. The actual programming of the programmable attenuator is accomplished by applying +12 volts to the programming lines that set the attenuator. The value of each programming line that is set to +12V is added to get the total attenuation. Here, the programming lines representing attenuation values of 1dB and 8dB are set to +12V. Thus, the total attenuation is 9dB.

plenty of safety margin (at least at the keying-tone frequency). If not, reduce the attenuation until the transmitter does key reliably. The maximum amount of attenuation that will still allow the transmitter to key reliably is equal to the safety margin of the system. Don't just check the transmitter keying. Check all the functions to see that they operate properly. There can be "holes" at certain frequencies on the control line, which may render certain functions inoperative, with less safety margin.

One final note

A reader, Rick Harris of Union Pacific Railroad, Salt Lake City, made the following observation about a test setup in the January issue of MRT. The test setup involved Figures 2, 3 and 4 in which a disconnected port on the duplexer was left unterminated during part of the test pro-

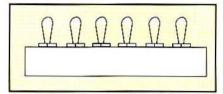


Figure 4. A simple remote control for the programmable attenuator such as the one shown in Figure 3 can be built into a small construction box using simple "bat handle" on/off toggle switches.

cedure. Harris asked "Shouldn't the unused port be terminated with a 50Ω termination?" Well, "technically speaking," unused ports should be terminated with the proper system impedance rather than left open. This is considered good standard practice. However, in this case, it probably would have had little effect on the test results because the frequency in use for that part of the test was far removed from the cavity's resonant frequency.

At the next opportunity I will try it both ways to know for sure. However, Harris' point is well taken—if in doubt, terminate!

Until next time-stay tuned!

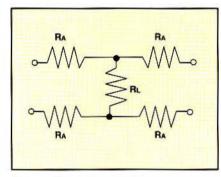


Figure 5: This balanced "H" pad is used on balanced audio lines such as radio remote-control lines supplied by telco.

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egulating technology

Not so fast

By Robert H. Schwaninger Jr.

The clock is ticking faster than a heart pumped full of digitalis, and the "times, they are a-changin." The industry is in overdrive—overheating in its efforts to bring forth new technology, services and delivery systems. Old competitors have become strategic partners. "Consolidation," "consensus" and "contiguous" are buzz words that fly through the pages of the industry press. Industry observers have come to wonder, "what happened?"

When the shape of the industry is changing rapidly, and we are all struggling to keep up, it's not easy to sit back and look at the big picture. Historical overview is difficult, and rarely does anyone find the time to ruminate and reflect on the effects of fifteen years of regulation of our industry. So, let's indulge ourselves and pause to reflect for a moment. There are lessons to be learned.

☐ To begin, let me admit my heresy at the outset. In this day of bridges to the next century, new paradigms of regulation and competition, and emerging technology, people looking backward for reference to the future are publicly lambasted. We who seek such references are not "team players" who root for each new idea and economic model, regardless of its

Schwaninger, MRT's regulatory consultant, is a partner in the law firm of Brown and Schwaninger, Washington, DC. He is a member of the Radio Club of America.

value. "New" and "bigger" are now equated with "better," but the factual support for this assumed equation is often lacking. Instead, our fidelity to futuristic follies is expected and demanded.

Consider the use of the word "digital," which the public and our Congress are asked to equate with "better than analog." But is it? Any honest designer will tell you that digital technology provides many benefits for many applications, but

it is not the "best" system for all applications. What the technology really provides in most applications is greater system capacity, benefits for system operators with greater inventory and use of the spectrum. Regardless, have we considered the public interest in the quality of voice transmissions? Usually not.

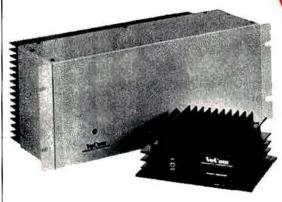
☐ The introduction of narrowband technologies in conjunction with spectrum refarming is another lesson. Touted



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as a method of attaining greater spectrum efficiencies, narrow bandwidths, again, do not produce the same voice quality, and it will be difficult or impossible to use narrowband for high-speed data transmissions. Yet, refarming is viewed as a fait accompli, despite its obvious shortcomings.

☐ Questions are now being raised about time-division multiple access (TDMA) as a method of increasing system capacity.



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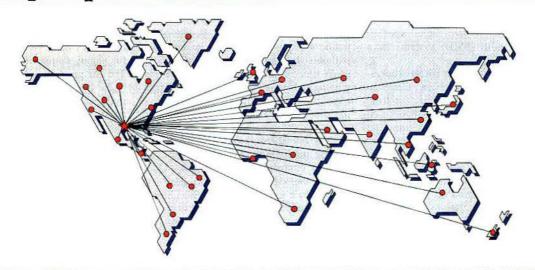
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Operators report that TDMA may not produce acceptable results in a wireless environment because of varying distances between base and receivers. ("Time" will tell). Meanwhile, the Motorola IDEN system has been pared-down in capacity from 6:1 to 3:1 over analog in an effort to improve voice quality. Digital cellular systems may be using an insufficient emission mask to avoid interference to adjacent systems, a problem digital specialized mobile radio (SMR) systems have evidenced for years.

☐ In its efforts to assist wireless operators in building systems rapidly, Congress has pitted system operators against local zoning boards. The backlash has raised costs, slowed zoning decisions and spawned litigation, and it will likely find its way to the U.S. Supreme Court to determine whether the federal government can usurp local authorities in determining local land use. Bettors on the outcome should give no more than even money.

☐ The FCC's decisions regarding auctioning of paging channels, to make paging licenses bigger overnight, fly in the face of UHF two-way system operators, basic exchange radio telephone service

(BETRS) systems and shared spectrum use under the private radio rules. No matter, it seems. Where there might exist "white space" to sell, the agency is moving forward without regard to the effect its actions might have.

The plan advanced by U.S. Sen. John McCain (R-AZ), chairman of the Senate Commerce Committee, to plan to sell TV channels 60-69, while earmarking some spectrum for public safety, is lauded by public safety representatives whose constituents desperately need relief. At the same time, commercial interests are beginning to bemoan the creation of a "spectrum glut" as the inflationary practices of the past few years begin to whittle down the revenue expectations of Congress. One could crow about just-deserts, if the investing public were not at such risk, as wireless companies' (whose book values rely on the value of spectrum inventory) begin to lose the confidence of Wall Street.

Already we are viewing the casualties of promised progress. Interactive video data services (IVDS) licensees have discovered that the FCC sold them a service without a supporting manufacturer, broadcast community or operational rules. Location-monitoring services are at a flying stop as they continue to reel under the agency's compromised decision, a decision that pleases no one. Interconnection, universal service, and "bill and keep" rules are being debated in federal court as the agency grapples with Congress' initiative to open the tap of competition between the largest carriers, while preserving the rights of smaller local exchange carriers (LECs) and common carriers. Billing for 800 numbers is set for review as the ramifications for paging companies are made apparent. The list goes on.

As backdrop to the chaos suffered throughout the industry, the Administration is debating whether greater foreign ownership should be allowed. Our regulatory ship is being pitched about on the winds of change and elected officials might ask foreign companies to take a cruise. Still, foreign investment guarantees bigger auction receipts, so the exploration goes on.

So, what happened? How did a stable industry that existed only a decade ago suddenly become a victim of violent upheaval? Three factors appear to have converged to create this chaos: greed by both the private and public sectors, the insupportable equation of public interest and administrative efficiency at any cost, and a lack of wisdom regarding the natural evolution of change. This final factor is, in some ways, the most vexing.

Congress and the FCC have combined to create legislative blinders that ignore the cost of change, the time necessary for change, the side effects of change and the victims of change. Progress is measured through spectrum distribution per auction dollar gained, without regard for service to the public or for the practicalities of business. Small operators are required to become large overnight to compete in auctions, large operators are required to convert billing practices overnight, local governments are required to forego zoning overnight, and private operators are required to refarm, retune and readjust overnight. Why? Because a regulator who has never operated as much as a crystal set writes a rule or law.

A small child anxious for the blossoms of spring might pull a flower out of the ground to try to make it grow. A person with knowledge and experience would let the flower flourish in its natural setting. A politician will jerk the flower out, then cover the distance between the dangling roots and the ground with manure. All of this fertilizer will burn the roots and, besides, it smells bad.



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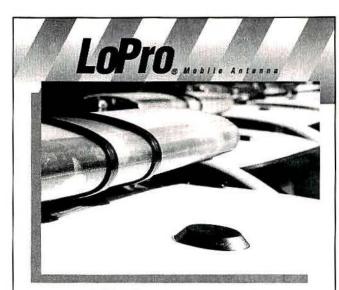


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Michigan upgrades public safety radio system

The first of four phases of an over-haul of the Michigan public safety communications system (MPSCS) has been completed on time and within budget, Gov. John Engler announced in February. The radio system was designed and manufactured by Motorola, Schaumburg, IL.



Left to right: Michigan State Police Capt. Jeff Steffel, commanding officer of the Communications Division, Gov. John Engler, State Police Director Col. Michael D. Robinson, and Jim Sarallo, Motorola corporate vice president for Radio Network Solutions, U.S. and Canada Group.

The new state police radio system is

operating as designed—with improved coverage and advanced performance—throughout southeast Michigan, Engler said. The MPSCS, which will replace the State Police's 1940s-vintage radio system, is expected to improve law enforcement and public safety and to serve the communications needs of state and local agencies. It is on schedule for statewide operation by late 1999.

Phase 2 work on the MPSCS has begun in southwest Michigan and is scheduled for completion in Fall 1998. The system's \$187-million cost is being funded by bonds sold by the state.

The existing radio system has many "dead spots" where troopers cannot communicate with their bases in certain parts of the state, said State Police Director Col. Michael D. Robinson.

"The new radio system is designed to provide us with 97% statewide coverage 100% of the time, which is a tremendous improvement," Robinson said.

The MPSCS is the first contracted statewide APCO Project 25-compliant system in the United States, Motorola said.

Engler said the state plans to expand the system so it eventually can support virtually instant vehicle registration information, occupant identification and driver's license systems. The system also will help officers generate investigation reports in their vehicles and send them directly to central data banks, ensuring that timely information about criminals is available quickly.

Downbanded cellular technology puts operator on SMR

Ericsson, Richardson, TX, has introduced its new downbanded cellular system with the launch of Hawaiian Wireless in Oahu. The system is the world's first total IS-136 time-division multiple-access (TDMA) network and the first cellular system to use specialized mobile radio (SMR) frequencies, Ericsson said.

Hawaiian Wireless uses the same digital IS-136 technology used by cellular and personal communications services (PCS) operators throughout the continental United States. Ericsson also supplied dual-mode (digital and analog), dual-band (SMR and cellular) wireless handsets that provide subscribers with nationwide roaming on the 850MHz cellular analog systems.

The downbanded system consists of a mobile switching center with a home location register and Ericsson's RBS 884 macro radio base stations, which have been modified for the new frequency spectrum. The RBS 884 base station can be configured for a single, two-or three-sector site.

Hawaiian Wireless was formed by Atlantic Cellular, which is reportedly studying the possibility of implementing digital cellular on SMR frequencies in other areas of the United States where the company has licenses for those frequencies.

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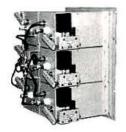
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News

CTIA comments on article examining association between wireless phones use, automobile accidents

An article in the February issue of The New England Journal of Medicine (NEJM) examined the relationship between wireless phone use and automobile accidents.

The wireless industry cooperated in the study, and the Cellular Telecommunications Industry Association (CTIA) concurred with the study's conclusion that drivers should be vigilant in maintaining safe driving practices. In regard to phone use, the researchers recommended that drivers avoid unnecessary calls, keep conversations brief and suspend conversations when driving conditions become hazardous.

The researchers in the NEJM article also cited the benefits of wireless phones in cars, particularly the ability to call for help after an accident. CTIA said an additional benefit is the ability to call police to report drunk, impaired and aggressive drivers. Each year, Americans make over 18 million emergency and 9-1-1 calls on wireless phones. The benefits and safety features associated with wireless phones in cars has led to joint efforts with the National Safety Council, the American Automobiles Association and Mothers Against Drunk Driving. Police agencies have said that phones in cars are valuable safety tools, CTIA said.

In regard to the study itself, CTIA responded by stating:

- ☐ This is a study of wireless phone users who were involved in accidents, not the preponderance of phone users not involved in accidents.
- The associated risks cited in the study deal with phone usage near the time of the accident, but not necessarily at the time of the accident. CTIA said the researchers acknowledged that none of the people they interviewed admitted to using a phone at the moment of the accident.
- A four-fold increase in risk cited in the study refers to the overall risk associated with driving. For example, if your chance of having an injury-producing accident is one in every 100,000 trips, then statistically, your chance of being involved in an accident in association with having used a wireless phone within a ten-minute period would rise to four in 100,000 trips.
- The results of the research deal with "association" not "cause." In other words, the study does not contend that phones were the cause of accidents. There are, of course, many items that can be associated with vehicle accidents including weather, drowsiness, speeding, alcohol or road conditions.
- ☐ From 1988 to 1995, in the United States, wireless phone users increased 1,685% to 34 million subscribers. During the same period, injuries resulting from auto accidents decreased by 16.6% and fatalities decreased by 26%.

Peninsula Wireless becomes Repeater Technologies

Peninsula Wireless Communications, Sunnyvale, CA, has changed its name to Repeater Technologies, hired new executives and arranged a round of financing to fund the company's growth in developing repeaters for the wireless infrastructure market. The 13-year-old company's board of directors said the new name was chosen "to reflect the firm's focus on repeater solutions for wireless network build-outs worldwide."

Corsair deploys fraud prevention in Southwest

Corsair Communications, Palo Alto, CA, has agreed to install its PhonePrint cellular fraud prevention system for GTE Mobilnet throughout its Texas and New Mexico markets. Corsair began installing the system in El Paso, TX, in February, followed by GTE's other Texas and New Mexico markets, which include Houston, Austin, Beaumont/Port Arthur, Galveston, Las Cruces and smaller markets. PhonePrint has disconnected more than 65 million fraudulent call attempts in 22 states.

Readers' choice

Of all the new products and services in the August 1996 issue, the one reprinted here generated the most reader requests for additional information. If you missed it the first time, here is your opportunity to acquire more information on it. Just circle the corresponding Fast Fact Card number on the card found in the back of this issue and mail the card to us.

GPS antenna receive technology comes in active, passive versions



Maxrad's GPSA (active version) and GPSP (passive version) global positioning system antennas offer active or passive

receive technology in an impact-resistant, dove-gray polymer shell. The antennas are designed and constructed to meet or surpass all of the current design specifications and will directly replace any similar antennas currently available. Various antennamounting options and configurations are available. BNC connectors are standard; other connectors are available on request.

Circle (500) on Fast Fact Card

Stand-alone platform tests both cellular and PCS frequencies

IFR Systems' 1900 CSA is a stand-alone platform for testing 400MHz-800MHz cellular and 1,900MHz time-division multipleaccess PCS applications. The platform performs comprehensive emulation of PCS base- and mobile-station operation. Available tests include AMPS/NAMPS, IS-91A, IS-136 compliance testing; CTIA analog/ digital authentication testing; and IS-136 hyperband handoff testing. The 1900 CSA verifies standards compliance and supplier interoperability of cellular and PCS subscriber and base-station equipment. Standard features include 2GHz frequency coverage, a built-in full-band spectrum analyzer, signal and tracking generators, duplex modulator and receiver (AM/FM/ PM/SSB/CW) and accurate power meter with 1mW to 50W range.

Circle (421) on Fast Fact Card

Front-display pagers offer feature option catering to a broad market

NEC America's Wireless Message Terminals Division has added three front-display, numeric pagers with enhanced feature options to the Message-Maker series. The new pagers contain specific feature sets that cater to a broad consumer market ranging from entry-level to high-end pager users. Topping the new pagers' list of features are the Message-Maker communications icons, enabling



pager users to communicate by using nine graphic symbols that represent common messages, such as "urgent" or "phone."

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New products

Repeater controller accepts overdialing to call mobiles



Connect Systems' repeater controller with duplex interconnect is designed for private systems requiring a desktop style repeater with full or half duplex interconnect. Designated as Model 8300D, this controller accepts overdialing to selectively call mobiles or portables using DTMF, CTCSS, DCS, two-tone or 5/6 tone formats. Or, use ringout if selective calling is not required. The 8300 can be programmed over the air using DTMF from any DTMF telephone or any DTMF phone plugged into the PROG jack. Ninety-nine speed dial memories, remote base operation and semi-duplex privacy are a few of this product's capabilities. Regenerated DTMF or pulse dialout assures reliable telco access.

Circle (423) on Fast Fact Card

Portables housed in die-cast metal

The HSX series portable radios from Haewa feature rugged die-cast metal



housings that make them suitable for public safety, law enforcement. industrial and commercial applications. The radios are available in lowband, mid-band and VHF frequencies. Features include 16 programmable channels, wideband operation. DCS, CTCSS, full scan, priority scan, cloning and PC programming. Controls are mounted on top for easy access. Op-

tions include speaker mics and vox handsfree ear mics.

Circle (424) on Fast Fact Card

Tone remote system offers direct control of the XTR series radios

IDA's model 24-66 tone remote controllers and model 20-27 tone remote termination panels are now available for use with Midland Syn-Tech XTR base stations and XTR mobiles used as base stations. The tone remote system provides direct control of the XTR series radios. Features include 99-channel control and display, scanning and deskset display update.

Circle (425) on Fast Fact Card

Spectrum analyzers cover 9kHz-8.1GHz frequency range



Anritsu Wiltron has expanded its portable spectrum analyzer platform with the MS2653A and MS2663A, which cover the 9kHz-8.1GHz frequency range. The dy-

UPS provides power protection in three-phase, true on-line design



The UPStation S3 for IBM availability services applications from **Liebert** provides uninterruptible power protection in a three-phase, true on-line design. Using the latest microprocessor switching technology, the system's on-line to-

pology, with its true sine wave generation, provides power protection as well as constant conditioning. With its size of 3.75 square feet, the S3 uses a small footprint. Designed for loads in the 12kVA-24kVA range, this device operates quietly, with audible noise of 57dBa.

Circle (427) on Fast Fact Card

Remote site monitor/controller reports 240 alarm conditions



The FLX remote site monitor and controller from **Barnett Engineering** is compact and capable of monitoring and reporting as many as 240 alarm conditions of all types, including digital, analog, loss of events, totalizers and RF power. Alarms can be monitored, announced and acknowledged over telephone lines, mobile radio systems, alphanumeric pagers. RS 232 ports and cellular telephones.

Circle (428) on Fast Fact Card

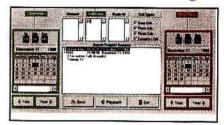
and the range of the MS2663A is 110dB. Average noise level is ≤-110dBm for the MS2653A and ≤-115dBm for the MS2663A. Total noise accuracy is ±1.3dB from 100kHz to 3.1GHz and ±1.8dB from 3.1GHz to 8.1GHz. Noise sidebands at 10kHz offset are ≤-90dBc/

namic range of the MS2653A is 105dB,

Hz for the MS2653A and ≤-100dBc/Hz for the MS2663A. The MS2653A is suited for maintenance of wireless communication equipment and devices, and the MS2663A is for manufacturing and installation applications.

Circle (426) on Fast Fact Card

Digital logging system retrieves recorded trunked radio messages



The SmartSTOR digital logging system developed by Swift Computers records and quickly recalls specific trunked radio conversations. Using a patent-pending process, SmartSTOR sorts out the randomly distributed transmission inherent on trunked channels and indexes them. Using the system's PC search screen, an authorized user can select and replay any transmissions of interest by date/time, channel, transmission type, talk group and/or unit ID's—including private calls and interconnects.

Circle (429) on Fast Fact Card

Arrestors protect from interference from colocated transmitters

LBA Technology's StrikeMaster family of quarterwave stub lightning arrestors is available in standard models from 130MHz to 3,000MHz. Three physical packages permit users to choose convenient configurations for field installation or OEM application. Incorporating a proprietary bandpass design, the Strike-Master also offers benefits to protect users against unwanted interference from colocated transmitters. The arrestors reject out-of-band signals, protecting users from intermod and desense problems found at crowded PCS/cellular colocation sites.

Circle (430) on Fast Fact Card

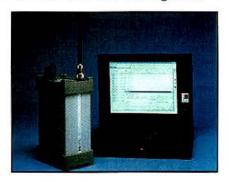
Speaker mic serves two purposes

The dual-purpose ESM from Earmark serves as a normal speaker mic for everyday operations, but with an SCBA mask, the unit converts to a mask communication system. Users can slip the secure pin connector from the SAC or throat microphone into the bottom of the ESM and send messages through an SCBA mask over the radio without losing control of the hand-held or breaking the mask seal. The ESM has a thumb-operated PTT switch, as well as a front-mounted volume switch, and can be used with gloves.

Circle (431) on Fast Fact Card

Standard test system locates holes in wireless network's coverage area

The standard test system from Hewlett Packard locates "holes" in a wireless network's coverage area as the user drives a vehicle into the service area to collect data. The system helps PCS providers and network equipment manufacturers launch their services more quickly and maintain high RF performance throughout the life of their networks. The HP E7450A system includes drive-test software and a digital PCS receiver and can be integrated with a customer's existing computers, antennas, mapping software and GPS receivers.



Circle (432) on Fast Fact Card

Coax prevents migration of water from the antenna to the receiver

The watertight flexible coax LMR-DB from Times Microwave Systems has the same properties as standard LMR cable. The addition of an inert polymeric flooding compound eliminates all paths for water migration and ingress. LMR-DB meets industry standard watertightness tests (ASTM D4565, REA PE-39, ANSI S-84-608), is suitable for aerial and direct burial applications, has a 10-year war-



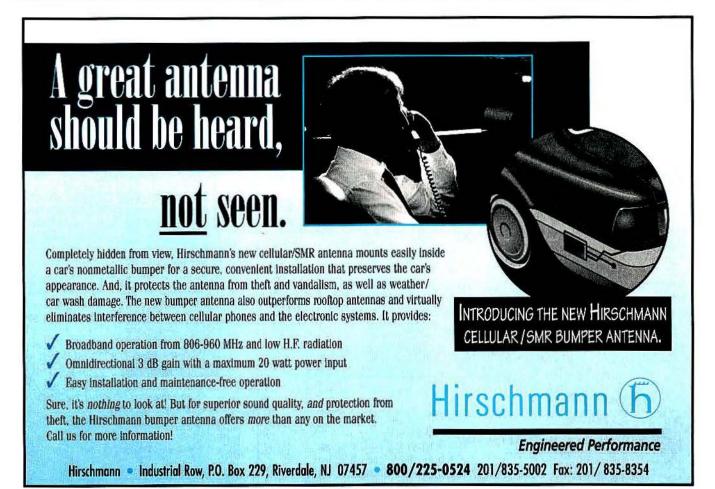
ranty and is available in LMR-400 through LMR-1700 sizes.

Circle (433) on Fast Fact Card

Surge arrestor's design makes installation simple and quick

Andrew's Arrestor Plus T-Series surge arrestor combines lightning protection and RF performance in a compact design. The integrated design with minimal components makes the arrestor easy to install. The unit is weatherproof and suitable for a variety of indoor and outdoor applications. Quarterwave surge protection technology ensures multi-strike protection.

Circle (434) on Fast Fact Card



New products

Signal generator offers multiple RF outputs in one unit

The Multi-Source Generator from Marconi Instruments offers multiple RF ouputs integrated in one unit. Calibrated output guarantees level accuracy, with good intermodulation and isolation performance for all types of receiver, sub-



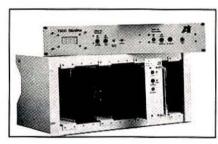
module and component testing. The 2026 is designed for multisource applications and includes a series of predefined application-specific test setups for simplicity. The unit combines as many as three independent RF sources in one instrument, with separate or combined outputs. Application modes address both analog and digital communication systems and subsystems. The user can, on one screen, monitor the level and frequency of each ouput, as well as the relationship between each source, and each signal source covers a frequency range from 10kHz-2.4GHz and can be controlled independently.

Circle (435) on Fast Fact Card

Modular paging transmitters, control links and receivers offer flexibility

The T800 series paging stations from Tait Electronics are modular systems that can be configured in various ways. Shown in the photo below is the T800 paging transmitter module with integral DFSK modulation installed in a 19" rackmount frame and a compact 3.5" × 19" Slimline panel-mount unit with paging transmitter and monitor modules or control link transmitter/receiver modules. Tait can also supply completely assembled paging RF stations with PA, power supply and other optional equipment. T800 paging transmitter modules are available in VHF, UHF and 800MHz models with direct FM modulation. The

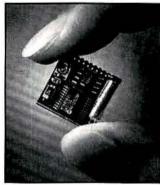
built-in DFSK modulator provides TTL or RS232 interface for POCSAG, Golay or similar paging data formats. DFSK data rates are 512-baud or 1200-baud, jumperselectable.



Circle (436) on Fast Fact Card

Miker ID. Their goose is cooked.





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Miker ID will end the stuck mikes and stop the horseplay. ID-3300 includes time-out and emergency. Fits inside the smallest portables. Fleet price \$75 ea. 800-521-2203.

Surge protection technology designed for fast reaction times

The Sandwich Block from Lightning Eliminators and Consultants is a patented device designed for fast reaction times, low clamp ratio and high reliability. The modular concept keeps the footprint small, and the integral heat sink dissipates heat. The "sandwich block" concept provides a high-speed, direct buss interface between the components in the block, allowing each metal oxide varistor's "full face" to see current at the same time while quickly handling multiple and continuous high-energy impulses. The unit handles from 25kJ to more than 50kJ of energy and is available in configurations from 120V to 4,160V with single-, split- and three-phase devices as high as 500,000A per phase.

Circle (437) on Fast Fact Card

Panel antennas maximize demanding site implementation guidelines

The series 3900 panel antennas from DAPA are designed to improve aesthetics and front-to-back ratio. They are suited for dense environments. Each panel is housed in a flat ABS radome with a UV protective coating. The antennas can be specified with a top-, bottom- or rear-feed input connector, which eliminates unnecessary cable bends and potential IM degradation. If ordered, DAPA will install the mechanical tilt bracket at the factory. An optional swivel is also available, which allows panel rotation 30° left or right in the azimuth.

Circle (438) on Fast Fact Card

Ground rod retains moisture, increases conductivity



Tower Structures' Valence rod is an electrolytic ground rod that provides a low-impedance and low-resistance ground. When used with Valence Galvanic backfill, the rod can solve difficult grounding problems. The rod contains a portion of bentonite for its moisture retention properties and bal-

ances the mixture with materials that increase conductivity. These added materials alleviate the shrinkage problems from using pure bentonite.

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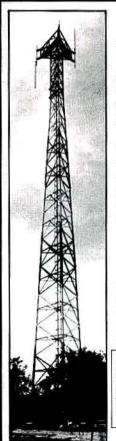
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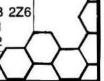
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1997 catalog offers test equipment, tools, supplies

A 252-page, full-line catalog from Contact East offers hundreds of new test instruments and tools for engineers, managers, technicians and hobbyists. Featured are products from brandname manufacturers for testing, repairing and assembling electronic equipment. New product highlights include Tektronix TDS 200 series compact digital scopes, Fluke 105B Scopemeter and BK Precision spectrum analyzers as well as a full selection of DMMs, portable and bench-top digital storage scopes, tool kits, power supplies, EPROM programmers, soldering/ desoldering equipment, breadboards, heat guns, datacom tools and testers, measuring tools, adhesives, precision hand tools and reference books.

Circle (410) on Fast Fact Card

Short-form catalog features power products

The eight-page, short-form Marconi catalog from Marconi Instruments includes information on Kikusui power products and the Zimmer Electronics power analyzers. The catalog features signal sources, microwave and RF analyzers, wireless test sets, dc power sources, electronic loads, safety testers and ac power sources.

Circle (411) on Fast Fact Card

Brochure gives information on infrared data links

The new Scientific Technologies (STI) brochure on wireless data communications offers information on the simple and flexible Optodata 53 series of infrared data links. The color brochure also features the Spectradata 5510/12, 5517/19, 5514/16, 5718 and 5736 series. The frequency band range, error checking/correction, baud rate, repeater capability, NEMA rating, certifications and other special features are are included.

Circle (412) on Fast Fact Card

Brochure presents new wireless testing instrument

IFR Systems' new brochure includes the performance enhancements and new features of the company's next-generation COM-120B. The full-color brochure details the instrument's radio communications, trunking, cellular and paging capabilities. Instrument functionality improvements, expanded hardware and software and easy-to-use features are also spotlighted. Product specifications are also provided.

Circle (413) on Fast Fact Card

Color brochure features autotesters

Anritsu Wiltron's new color brochure contains information on the convertible SWR autotester components. Convertible SWR Autotesters reduce maintenance costs without using error-prone test port adapters or connector savers. They reduce capital equipment and maintenance costs. A single autotester measures the return loss or SWR of devices with SMA, 3.5mm, or K (2.92mm) connectors. Six interchangeable test port heads (male and female for each connector standard) are precisiontuned to the convertible SWR autotester's internal bridge circuit.

Circle (414) on Fast Fact Card

Brochure covers cellular test systems, attenuators

A new "Cellular and PCS Capabilities" brochure is available from JFW Industries. This 12-page brochure features information on cellular test systems, attenuators and power dividers designed specifically for applications in cellular and PCS markets.

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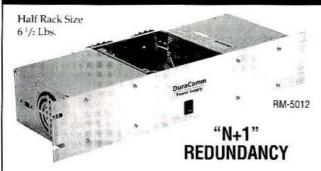
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P eople









Shaffer

Harrison

Quinlan

ın Nielsei

Changes at Midland USA, Kansas City, MO, involving sales of conventional FM two-way land mobile radios and trunked SMR (linear modulation technology) communications equipment:

Stan Shaffer advances from area sales manager to western regional sales manager in Lakewood, CO, replacing Mahlon "Mal" Harrison, who moves up to dealer marketing manager in Las Vegas.

Chris Quinlan leaves SND Communications, Bellingham, WA, as sales and marketing manager to become Midland's area sales manager in Bellingham, covering Washington, Oregon, Idaho and Montana.

Craig Nielsen exits Durkin Hayes Publishing, Fresno, CA, as West Coast regional manager to become Midland's area sales manager for California, Nevada and Utah, with an office in Fresno.

Bob Bagley departs Pioneer Standard Electronics, Phoenix, as account executive, to become Midland's area sales manager for Arizona, New Mexico and Colorado, with an office in Phoenix.

Charles Wright leaves Nextel Communications, Lexington, MA, as corporate account sales manager to become Midland's area sales manager for New York and the New England states.

Clyde Keith exits Marketronics, Fort Lauderdale, FL, to rejoin Midland as area sales manager for Florida with an office in Longwood, FL.

Patricia G. Hales, director of finance and administration at SmarTrunk Systems, Hayward, CA, advances to vice president of finance and administration.

Charles Cotherman leaves Small Business and Technology Development Center, Greenville, NC, as general business counselor to join Carolina Global Maps, Greenville, as president.

Jan Steven Zwaik leaves Geotek Communications, Montvale, NJ, as vice president of New York markets to join Chadmoore Wireless Group, Las Vegas, as chief operating officer.

Richard H. Blackwell Jr., principal engineer at Boonton Electronics, Parsippany, NJ, advances to director of engineering.

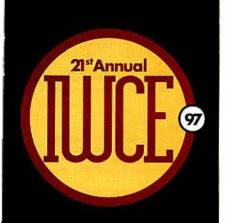
Changes on the Personal Communications Industry Association (PCIA) board of directors, Alexandria, VA:

Daniel C. Riker, chief executive officer of Pocket Communications, Washington, DC, becomes chairman of the PCIAboard.

Terry Sullivan, president of American Paging, Minneapolis, accepts the seat originally held by John Schaaf of American Paging.

John Egidio, executive vice president for Geotek, Scarboro, ME, serves on the board in place of Mike Hirsch, also from Geotek.

Jordan Roderick, president of the messaging division at AT&T Wireless Services, Bellevue, WA, accepts the seat originally held by Robert Croft of AT&T Wireless.



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etters from readers

Spectrum refarming seals end to dealer participation in customer choice

The Spectrum Refarming Docket boondoggle originally created by former Private Radio Bureau Chief Ralph Haller is re-emerging in force. Be certain it will ensure radio communications dealers a permanent massive crop failure not unlike that experienced by Oklahoma Dust Bowl farmers during the 1930s depression period.

John Steinbeck's 1937-era novel The Grapes of Wrath depicted the Oklahoma farmers' loss of their homes through ensu-

ing bank foreclosures and their moving to California for a new start only to endure further suffering. Is there a difference between today's dealers and the aggrieved farmers in the 1930s?

Yes. The farmers had no choice; the radio communications equipment sales and service dealers do, but will not have the courage to fight it.

This was shown in the late 1980s when more than 8,000 radio communications deal-

ers laid down, rolled over and weren't even thrown a bone by the victorious lobby groups who then turned these dealers into their passive not-for-pay sales force.

Grapes of Wrath? Are you kidding? It has been ten years now, and these dealers

HE SAYS IT WASN'T HIS FAULT.

TWO-WAY-RADIO DEALERS

ers and participating in forcing them to pay money for alleged unlawful monopoly "frequency coordination" services.

are still taking money from their custom-

The 1986 FCC Docket 83.737 elimination of radio system users' choices for frequency coordination precluded the timehonored field survey method. The FCC created favored monopoly coordinators for hire whose only true qualification for monopoly status was their unfounded claim to representative voice of each of the user 22 Pri-

vate Radio Service frequency blocks.

More than 8,000 dealers, many even though members of these organizations, soon found the "representatives" true color and their membership value when their coordination service bills jumped to more than 400%.

The irony of it all is for some time now, as predicted, any person can purchase a quarterly regional CD disc with complete, exact licensee data for only \$99, which enables free enterprise lo-

cal and area frequency coordinations.

Well dealers, "What ye sow, so shall ye

Enjoy your crop failure.

Merrill T. See Kalamazoo, MI

Editor's note:

We've heard from two sharp-eyed readers, Arch Doty of Fletcher, NC, and Jay Thompson of California (San Diego-area fax number) about our proofreading for February's "Technically Speaking" column. Captions for Figures 2 and 4 should refer to a 75Ω feedpoint impedance for the antenna, not a 75W impedance.

Thompson also points out that the dif-

Clarification

In the March 1997 feature "Multiprotocol Trunking and Networking," by Craig S. Johnson, two different working switches manufactured by SmartLink, Raleigh, NC, are described. The smaller of the two switches was de-

ference between 931.7125MHz and 931.6875MHz actually is 25kHz, not the 250kHz figure that slipped past us, reaching print in paragraph six on page 34 in David Ludvigson's article about paging receivers.

Thanks to you both for the careful reading and for letting us know.

-Don Bishop

scribed as handling as many as five sites and 50 channels. After the issue had gone to press, it was learned the smaller switch now handles as many as 32 sites and 50 channels.



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Although the explanations of the latest developments make good articles, so do tutorials that explain basic subjects. Reviews of digital signal processing, microwave system design and software have proven popular, for example. "How-to" descriptions are well received.

Editorial assistance

Some articles arrive ready to be published. If an article is not quite ready for publication, our editors can make the necessary modifications, sometimes requiring only a telephone conversation with the author. If for some reason an article must be returned, suggestions are included for revisions that would make it ready to publish. A set of guidelines for writing is available for the asking.

Artists are available to prepare artwork, such as drawings and graphs. Sketches submitted can be redrawn for illustrations. Camera-ready artwork is welcome, also.

Color photos are considered for use on the cover; slides and transparencies work best as cover illustrations. Otherwise, photos may be submitted as slides, transparencies or prints. If you would like to submit a picture as a possible cover illustration, we recommend you talk with an editor to increase your chances of obtaining a usable photo on the first try.

We have editors who love to help people prepare articles for the magazine. If you are undecided whether your topic might be suitable or if you need help at any stage in the writing process, please call. We would love to hear from you.

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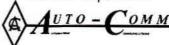
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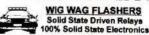
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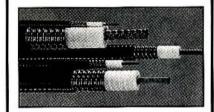
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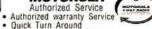
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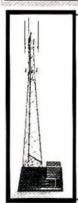
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Circle (2) on Fast Fact Card



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Automatic Morse Station Identifier, Meets all FCC ID Requirements. Fully field programmable with included keypad. 1.85" x1.12" x.35"



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Surface Mount Component Kits for repairing SMT circuits. CC-1 for capacitors/CR-1 for resistors.



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Two-tone Sequential Encoder. Sub-assembly mounts inside radio or other enclosure. Multiple call capability. 1,25" x 2.0" x .4"



Two-tone Sequential Decoder. Programmable unit provides switched outputs from two-tone paging calls. 1.25" x 2.0" x .4"



Single Function DTMF Decoder. Provides switch outputs via DTMF. 1.25" x 2.0" x .4"



Multiple Call POCSAG (RPC-1) Paging Encoders. Where direct control of local area paging is desired. 1.78" x 1.03" x .35"



Digital Coded Squelch Encoder-Decoder. Programmable to all codes. 1.36" x 1.18" x .25"



Programmable CTCSS Encoder-Decoder. Tone squelch for any FM transceiver. 1.25" x 2.0" x 4"



Sub-miniature Programmable CTCSS Encoder-Decoder. 1.7" x .78" x .25"



Sub-miniature CTCSS Encoder. Jumper programmable. .53" x 1.0" x .16"



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